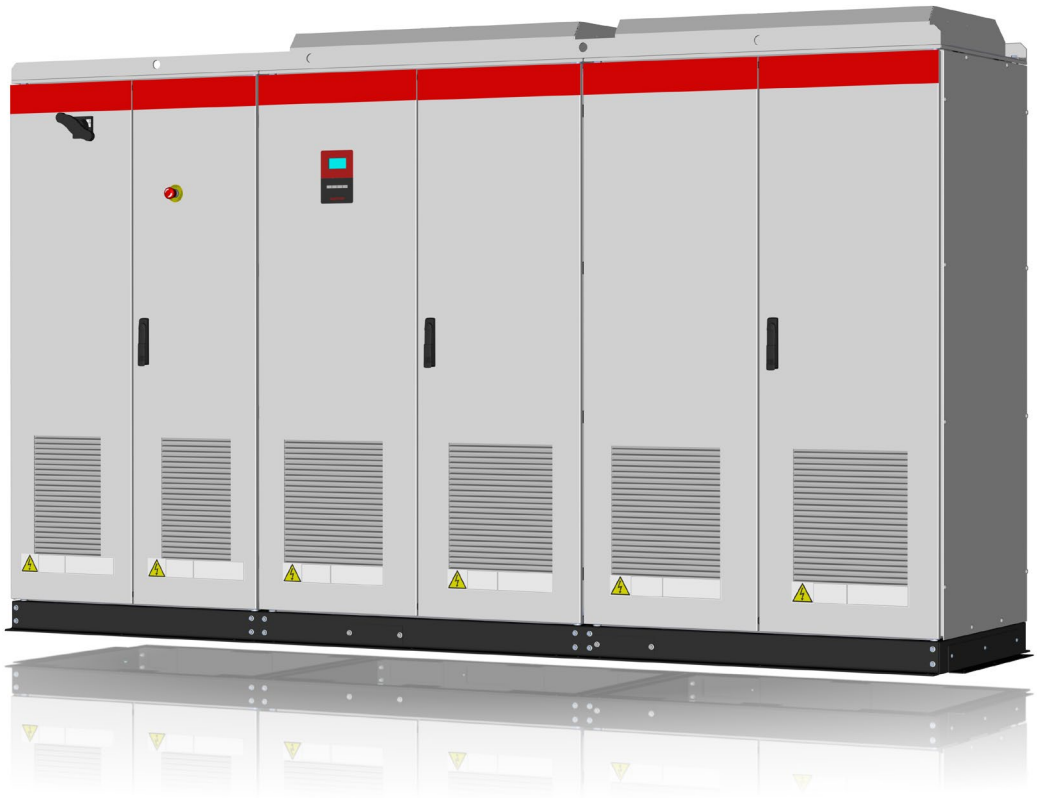
Ingeteam



INGECON SUN PowerMax

X DCAC Indoor

Installation and usage manual

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05/2015

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INGECON SUN PowerMax

X DCAC Indoor

Installation and usage manual

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The conformity of the document content with the hardware described has been checked. However, discrepancies may exist. Liability will not be assumed for total concordance. The information contained in this document is regularly reviewed and it is possible that there may be changes in subsequent editions. Other functions may be available which are not covered by this document.

This document may be changed.

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1. About this manual

The purpose of this manual is to describe the INGECON SUN PowerMax TL X DCAC Indoor units and to provide appropriate information for their correct reception, installation, start-up, operation and maintenance.

1.1. Scope of application

This manual is applicable to the following units:

Complete name	Abbreviation
INGECON SUN 275TL X220 DCAC Indoor	275TL X220 DCAC Indoor
INGECON SUN 350TL X275 DCAC Indoor	350TL X275 DCAC Indoor
INGECON SUN 380TL X300 DCAC Indoor	380TL X300 DCAC Indoor
INGECON SUN 400TL X320 DCAC Indoor	400TL X320 DCAC Indoor
INGECON SUN 440TL X345 DCAC Indoor	440TL X345 DCAC Indoor
INGECON SUN 460TL X360 DCAC Indoor	460TL X360 DCAC Indoor
INGECON SUN 500TL X400 DCAC Indoor	500TL X400 DCAC Indoor
INGECON SUN 535TL X420 DCAC Indoor	535TL X420 DCAC Indoor
INGECON SUN 410TL X220 DCAC Indoor	410TL X220 DCAC Indoor
INGECON SUN 520TL X275 DCAC Indoor	520TL X275 DCAC Indoor
INGECON SUN 570TL X300 DCAC Indoor	570TL X300 DCAC Indoor
INGECON SUN 605TL X320 DCAC Indoor	605TL X320 DCAC Indoor
INGECON SUN 660TL X345 DCAC Indoor	660TL X345 DCAC Indoor
INGECON SUN 690TL X360 DCAC Indoor	690TL X360 DCAC Indoor
INGECON SUN 750TL X400 DCAC Indoor	750TL X400 DCAC Indoor
INGECON SUN 805TL X420 DCAC Indoor	805TL X420 DCAC Indoor
INGECON SUN 550TL X220 DCAC Indoor	550TL X220 DCAC Indoor
INGECON SUN 695TL X275 DCAC Indoor	695TL X275 DCAC Indoor
INGECON SUN 760TL X300 DCAC Indoor	760TL X300 DCAC Indoor
INGECON SUN 800TL X320 DCAC Indoor	800TL X320 DCAC Indoor
INGECON SUN 880TL X345 DCAC Indoor	880TL X345 DCAC Indoor
INGECON SUN 920TL X360 DCAC Indoor	920TL X360 DCAC Indoor
INGECON SUN 1000TL X400 DCAC Indoor	1000TL X400 DCAC Indoor
INGECON SUN 1070TL X420 DCAC Indoor	1070TL X420 DCAC Indoor

1.2. Recipients

This document is intended for qualified personnel.

The status of qualified personnel referred to in this manual will be, as a minimum, that which meets all the standards, regulations and laws regarding safety applicable to the tasks of installing and operating this unit.

The responsibility for designating qualified personnel will always fall to the company to which the personnel belong. It is necessary to decide which workers are suitable or not for carrying out specific work to preserve their safety at the same time as complying with occupational safety legislation.

These companies are responsible for providing appropriate training in electrical equipment to their personnel and for familiarising them with the contents of this manual.

1.3. Nomenclature

This document will refer to the various models of inverter of the INGECON SUN PowerMax family by both their full name and their abbreviation. They will also be referred to generically as *inverter* or *unit*.

In this manual, the letter *n* refers to the power module number (from 1 to 4) and U1n to the electronics block number.

> Q2n refers to the Q2 circuit breaker protection on power module n. For example, Q23 refers to the Q2 circuit breaker protection on power module 3.

U1nXAC.2 will refer to terminal XAC.2 on electronics block n. For example, U14XAC.2 refers to terminal XAC.2 on electronics block 4.

1.4. Symbols

This manual uses various symbols to emphasise and highlight certain texts. The general meanings are explained below.

General warning.

Electrical danger.

Hot surface.

General information.

Read the section indicated in this manual.

Prohibition.

2. Unit description

2.1. Overview

An inverter is an electronic unit used to convert direct current to alternating current. The function of these units is to convert the direct current generated by photovoltaic solar panels to alternating current and so enable it to be fed to the electricity grid.

These devices are designed for use in an enclosed electric area.

2.2. Electrical characteristics of the unit

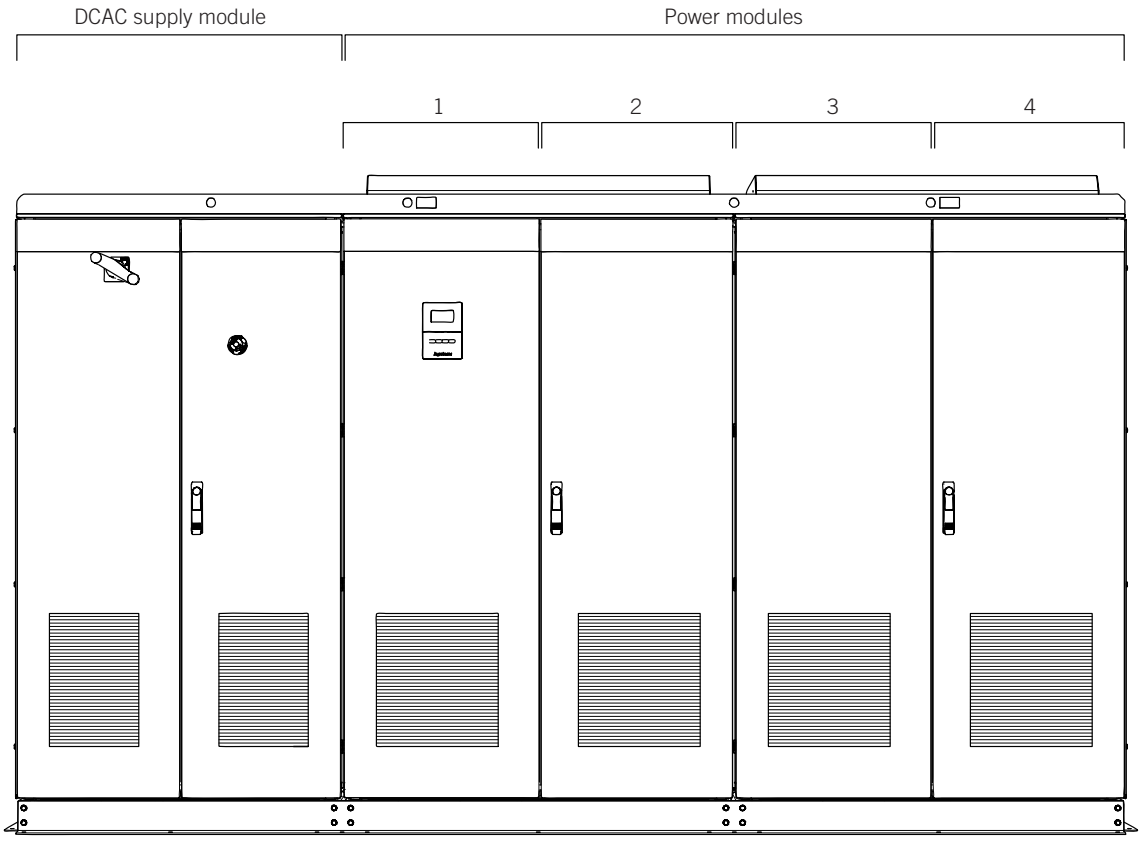
The units in this manual have been designed in accordance to the standards *IEC62109-1* and *IEC62109-2*. They particularly respond to the following characteristics.

- They are designed to follow at least *Overcurrent Category 2* in the continuous current cycle and *Overcurrent Category 3* in the alternating current cycle.
- This is a *Class I* protection device.
- The power factor range is 0 ~ 1.
- The maximum start-up current is 121 A and with a duration of 0.6 ms.

Maximum short circuit current	
Number of power modules	**Maximum admitted short circuit current**
2 power modules	1104 A
3 power modules	1656 A
4 power modules	2208 A

2.3. Structure of the unit

These units feature an DCAC supply module and may have 2, 3 or 4 power modules.



DCAC supply module

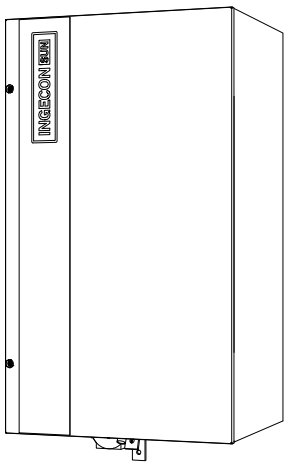
This module groups together the PA array feed (DC part), the grid connection feed (AC part) as well as various options and kits.

Power module

These units are modular in structure. Each of the individual modules making up the unit is called a power module.

Electronics block

Each power module has an electronics block. This block groups together the power module parts which require more physical protection, such as the control card, uptake card, IGBTs, etc..

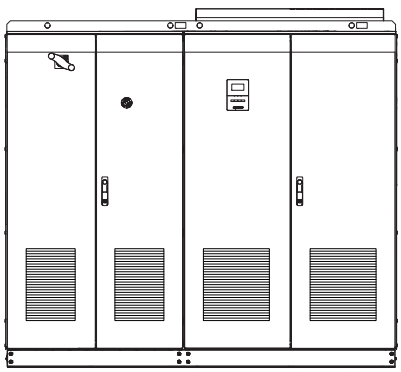


2.4. Models

Depending on the number of power modules and module types, the models of this family are differentiated as shown in the following table:

Number of modules	Type of module	Model
2 power modules	140 kW - 220 VAC	275TL X220 DCAC Indoor
	175 kW - 275 VAC	350TL X275 DCAC Indoor
	190 kW - 300 VAC	380TL X300 DCAC Indoor
	200 kW - 320 VAC	400TL X320 DCAC Indoor
	220 kW - 345 VAC	440TL X345 DCAC Indoor
	230 kW - 360 VAC	460TL X360 DCAC Indoor
	250 kW - 400 VAC	500TL X400 DCAC Indoor
	270 kW - 420 VAC	535TL X420 DCAC Indoor
3 power modules	140 kW - 220 VAC	410TL X220 DCAC Indoor
	175 kW - 275 VAC	520TL X275 DCAC Indoor
	190 kW - 300 VAC	570TL X300 DCAC Indoor
	200 kW - 320 VAC	605TL X320 DCAC Indoor
	220 kW - 345 VAC	660TL X345 DCAC Indoor
	230 kW - 360 VAC	690TL X360 DCAC Indoor
	250 kW - 400 VAC	750TL X400 DCAC Indoor
	270 kW - 400 VAC	805TL X420 DCAC Indoor
4 power modules	140 kW - 220 VAC	550TL X220 DCAC Indoor
	175 kW - 275 VAC	695TL X275 DCAC Indoor
	190 kW - 300 VAC	760TL X300 DCAC Indoor
	200 kW - 320 VAC	800TL X320 DCAC Indoor
	220 kW - 345 VAC	880TL X345 DCAC Indoor
	230 kW - 360 VAC	920TL X360 DCAC Indoor
	250 kW - 400 VAC	1000TL X400 DCAC Indoor
	270 kW - 420 VAC	1070TL X420 DCAC Indoor

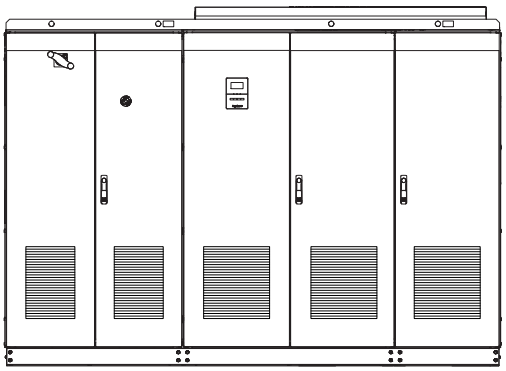
Models with 2 power modules



These units include:

- 2 electronics blocks.
- 1 MPPT tracker.
- 1 motorised DC isolating switch.
- 1 overvoltage protection element on the DC side.
- 1 overvoltage protection element on the AC side.
- 1 AC isolating switch.

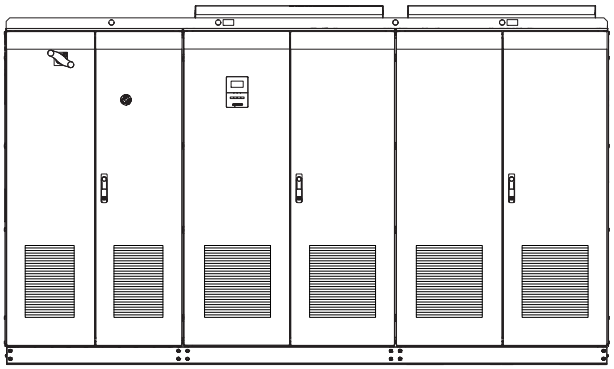
Models with 3 power modules



These units include:

- 3 electronics blocks.
- 1 MPPT tracker.
- 1 motorised DC isolating switch.
- 1 overvoltage protection element on the DC side.
- 1 overvoltage protection element on the AC side.
- 1 AC isolating switch.

Models with 4 power modules



These units include:

- 4 electronics blocks.
- 1 MPPT tracker.
- 1 motorised DC isolating switch.
- 1 overvoltage protection element on the DC side.
- 1 overvoltage protection element on the AC side.
- 1 AC isolating switch.

2.5. Available kits

These units may include the following kits:

- LVRT kit.
- Kit for motorization of AC circuit breaker.
- Kit for reading DC input string current.
- Kit for reactive power regulation with no PV array power.
- AC wattmeter kit.

- AC Insulation monitor kit.
- PV array grounding kit.

LVRT kit

This kit is supplied for cases where regulations require that the inverter be capable of withstanding grid voltage drop outs.

Including additional hardware (UPS) enabling the inverter to remain connected to the grid during these types of events.

LVRT kit must be specified in the inverter configuration before delivery.

Enables adaptation and governance to all existing medium voltage regulations.

Kit for motorization of AC circuit breaker

As standard, the AC circuit breaker allows remote tripping, but not automatic resetting. The circuit breaker installed is motorized using this kit to enable remote tripping or closing operation.

Kit for reading DC input string current

The kit for reading DC input string currents is available as an option for monitoring the current of each of the unit's input strings. This device implements the following functions:

- Detection of anomalous currents by string or by fault.
- Detection of blown PV input fuses.
- Storage of data strings.

Kit for reactive power regulation with no PV array power

This kit enables reactive power to be generated during the night in order to increase voltage stability and reduce loading on power grids.

AC wattmeter kit

The AC wattmeter kit consists fitting a wattmeter to the investor in order to measure the voltage, current and power levels at the output of the unit.

A single measurement is made for all outputs.

Monitoring of this item can be accessed through the unit's RS485 serial communications.

The main monitored parameters permitted by this kit are:

- Voltage. Mean and maximum values.
- Active, reactive and apparent power, by total and by phase.
- Power factor.
- Current and voltage harmonics (up to the 51st).

AC Insulation monitor kit

A dedicated AC insulation monitor needs to be installed depending on the requirements of the country's regulations. This monitors the insulation of the AC part of the inverter between the unit output and the connection to the medium voltage transformer.

This kit has a volt-free output which serves to monitor insulation failure.

The user is responsible for wiring and monitoring this kit.

The kit does not direct affect inverter operation (it does not show an alarm or any reason for shutdown).

PV array grounding kit

This kit makes it possible to ground the negative or positive pole of the DC input. The PV array is grounded by a thermomagnetic circuit breaker that connects one pole of the PV array, negative or positive, to ground. The polarity of the ground connection depends on the type of panel technology.

The thermomagnetic protection opens the PV array connection to ground when an insulation fault in the PV array generates a current through the connection which is greater than the protection's tripping current.

The protection will be monitored by the inverter control, and when the thermomagnetic circuit breaker opens the connection of the PV array to ground, the control will shut down the unit, triggering the 0x0200 DC Protection alarm.

2.6. Options

The standard units provide the ability to set various standard options. The installer can decide to use them or not depending on the requirements of each installation.

See Section *"12. Connection options"*.

2.6.1. Monitoring components external to the unit

This option allows the unit to monitor the proper functioning of components which are external to it.

This monitoring is done by using normally closed voltage-free contacts. Should one of the contacts be open (due to a fault in the monitored item) the inverter will generate an alarm and shut down.

2.6.2. DC isolating switch remote control

This option allows remote control (opening and closing) of the DC isolating switch of the unit using a Normally Closed contact.

When the contact is closed the isolating switch is in the On position and if the contact is open the switch changes to the Off position.

2.6.3. Insulation fault /grid connection

The inverter incorporates a normally open volt-free auxiliary contact, that can carry out one of these two functions:

Detecting an insulation fault in the DC circuit

- Open contact: there is no insulation fault in the DC circuit.
- Closed contact: there is an insulation fault in the DC circuit.

Indicator showing that the unit is connected to the mains via its internal contactor

- Open contact: internal contactor for connecting to the grid is open; the inverter is not connected to the grid.
- Closed contact: internal contactor for connecting to the grid is closed; the inverter is connected to the grid.

Regardless of the setting of this contact the unit continues to measure the insulation of the DC part.

2.6.4. Remote AC circuit breaker tripping

This option is included as standard in equipment incorporating an AC circuit breaker.

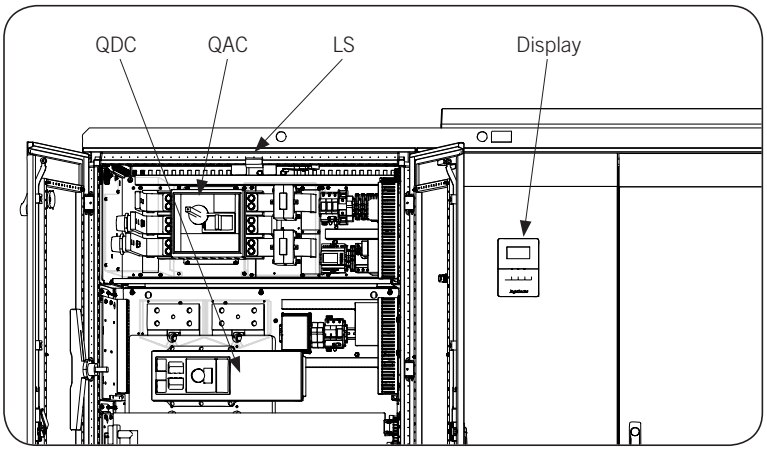
It enables remote tripping (opening) of the AC circuit breaker using an external 220 VAC signal. Since remote tripping is not allowed, the circuit breaker must be reset manually.

2.7. Location of components

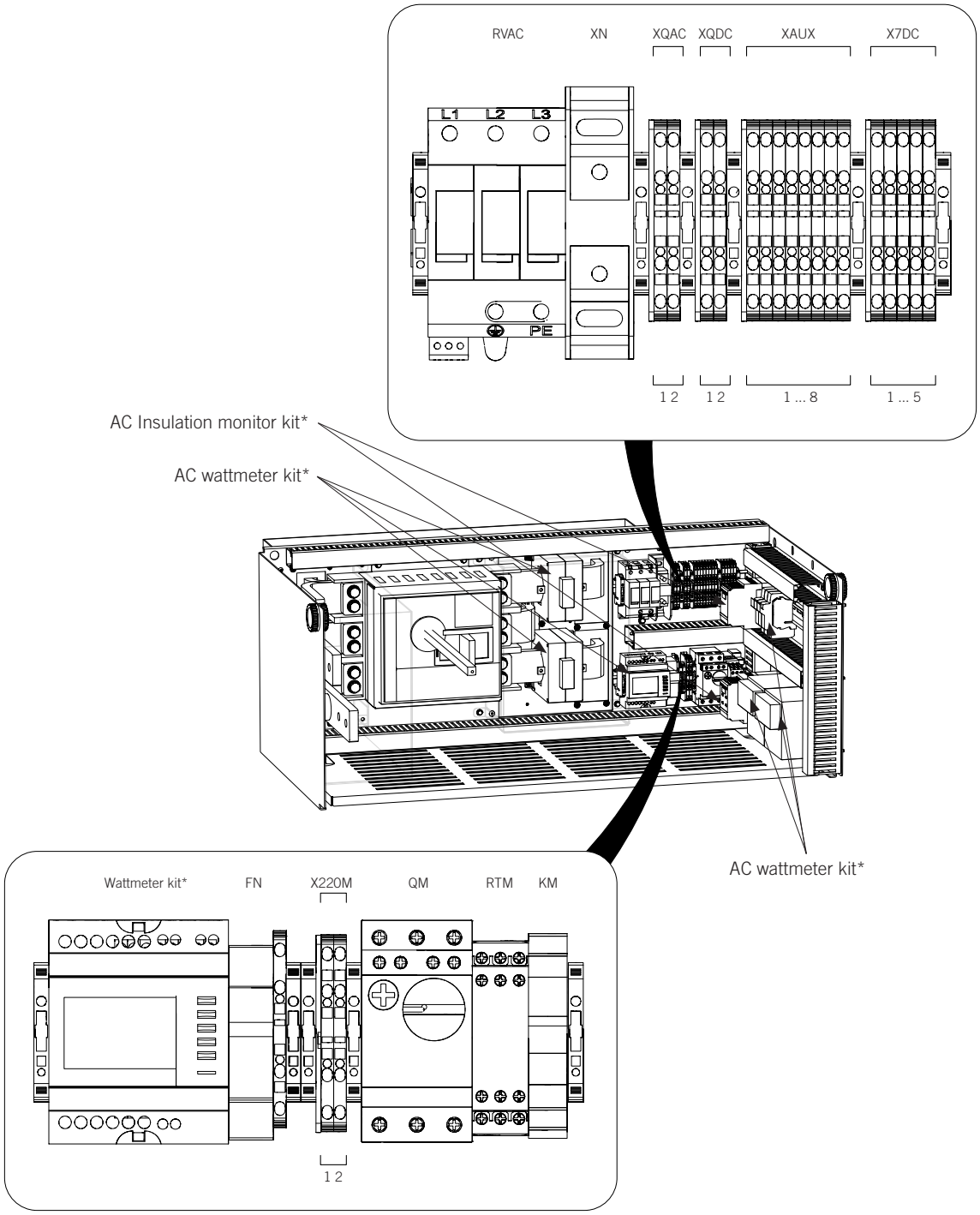
This section describes graphically the location of the main components of the unit. Throughout the document reference is made to this section repeatedly in order to facilitate the location of these elements.

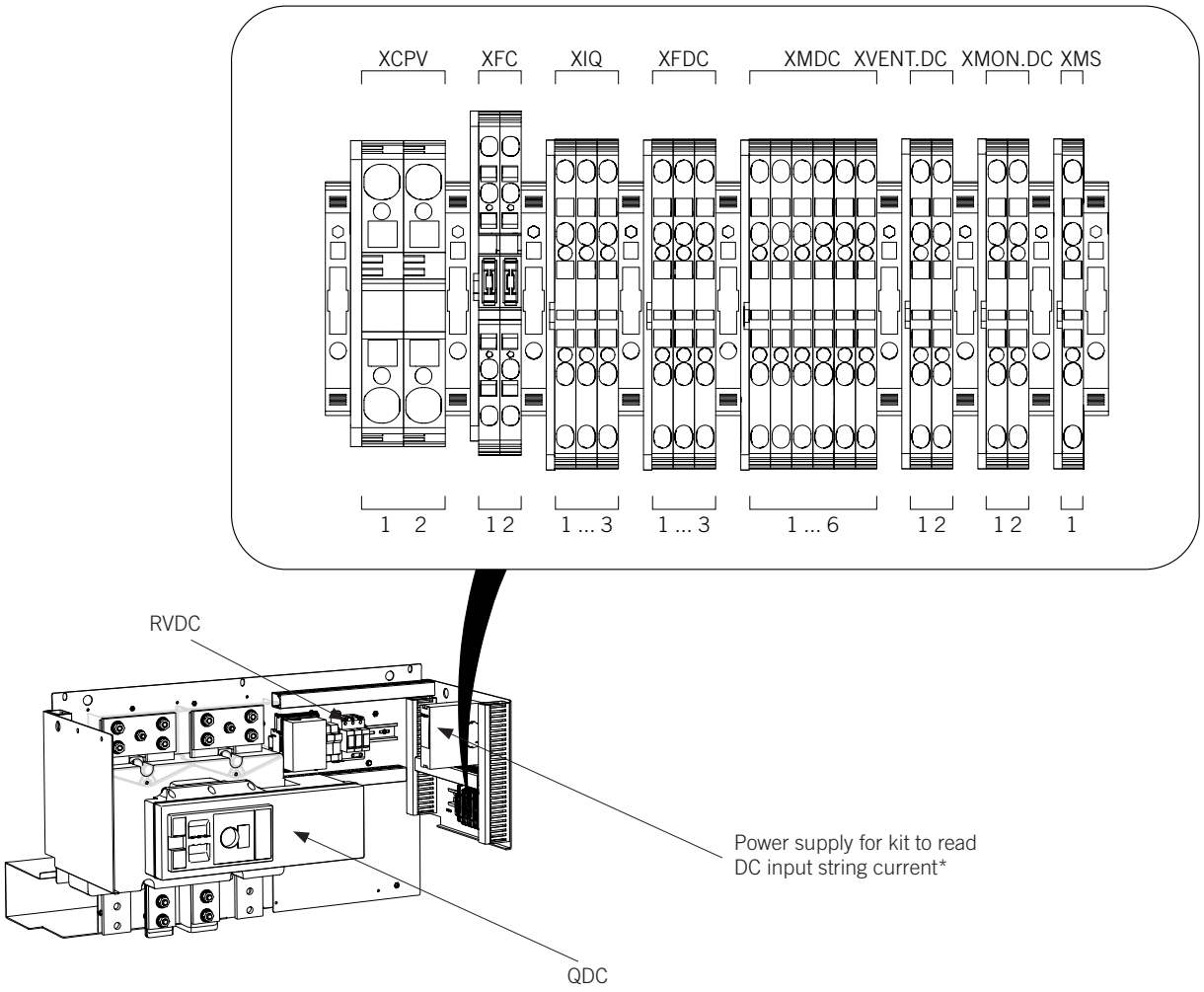
2.7.1. DCAC supply module

Overview

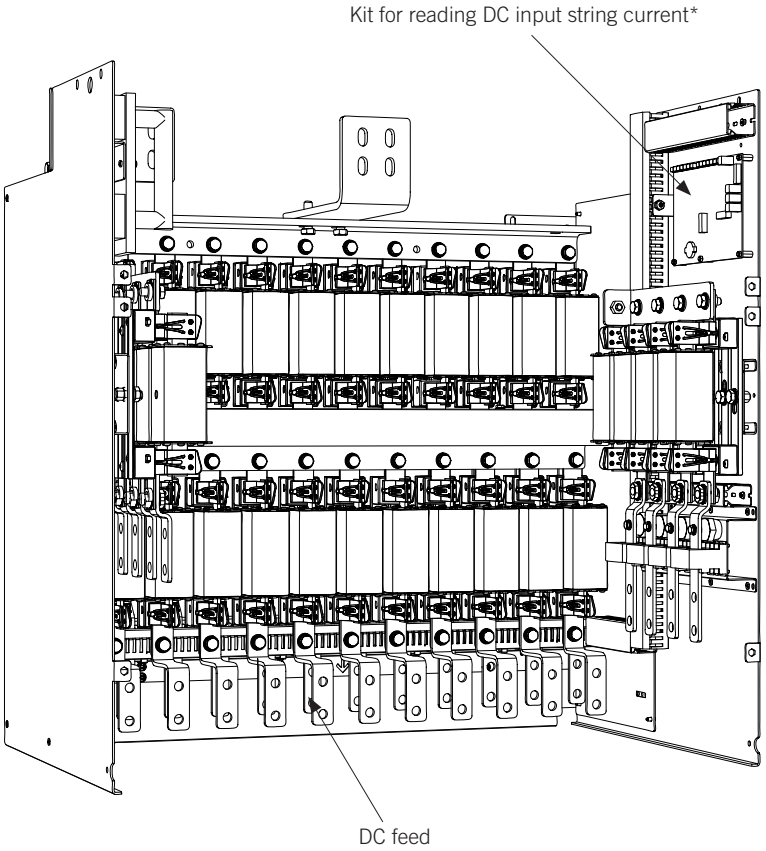


Upper front mounting plate




XCPV
XFC
XIQ
XFDC
XMDC
XVENT.DC
XMON.DC
XMS
1 2
1 2
1 ... 3
1 ... 3
1 ... 6
1 2
1 2
1
RVDC
Power supply for kit to read
DC input string current*
QDC

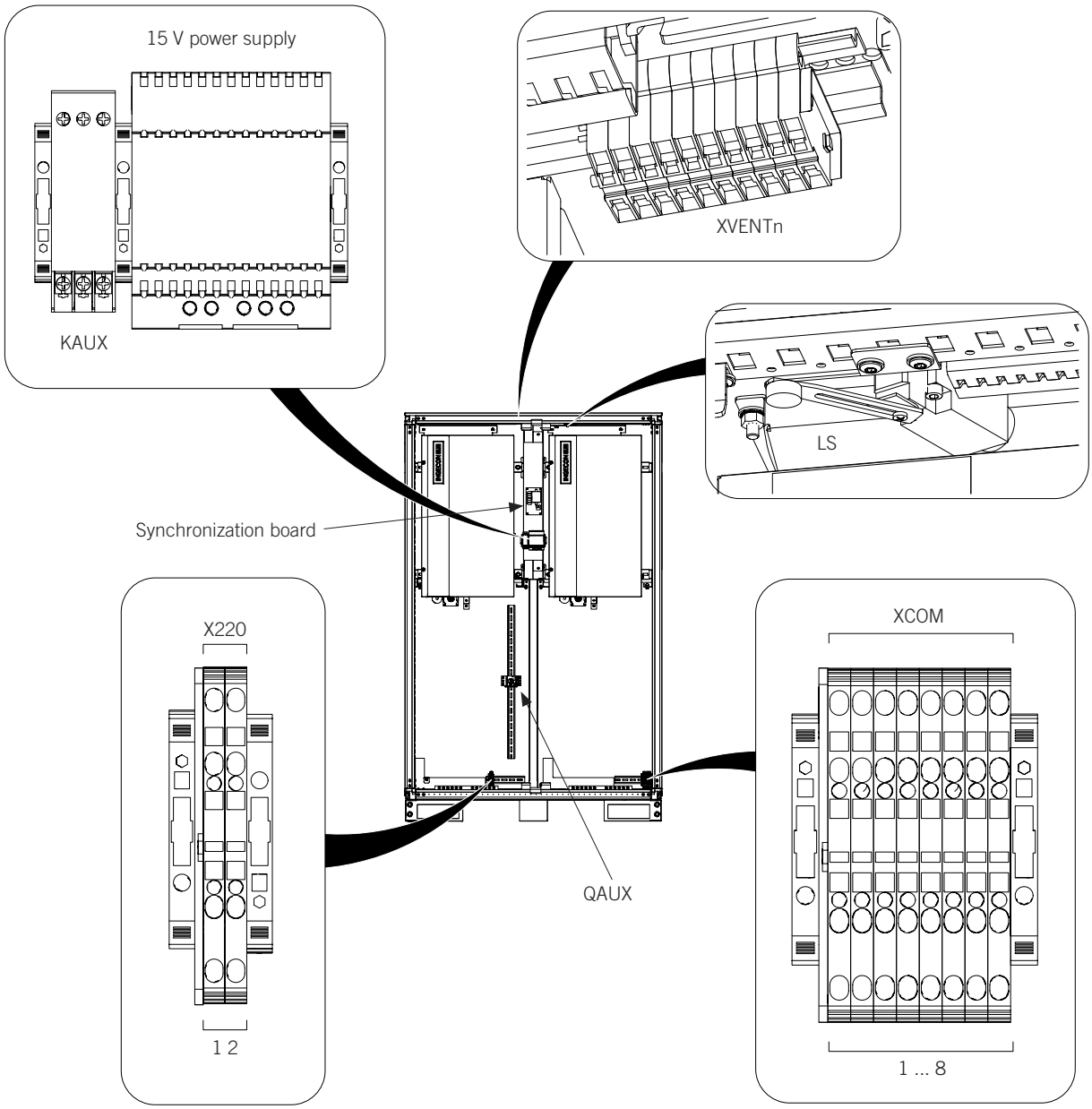
Lower front mounting plate

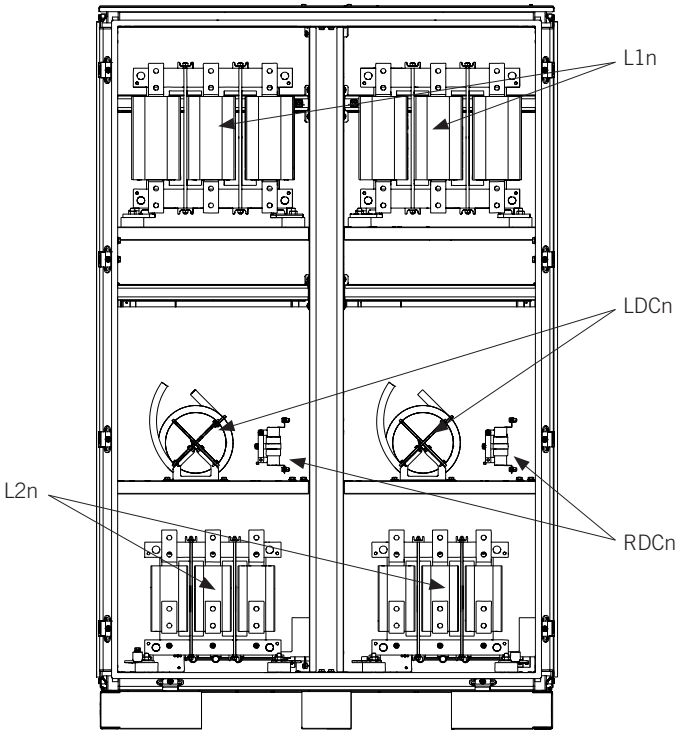


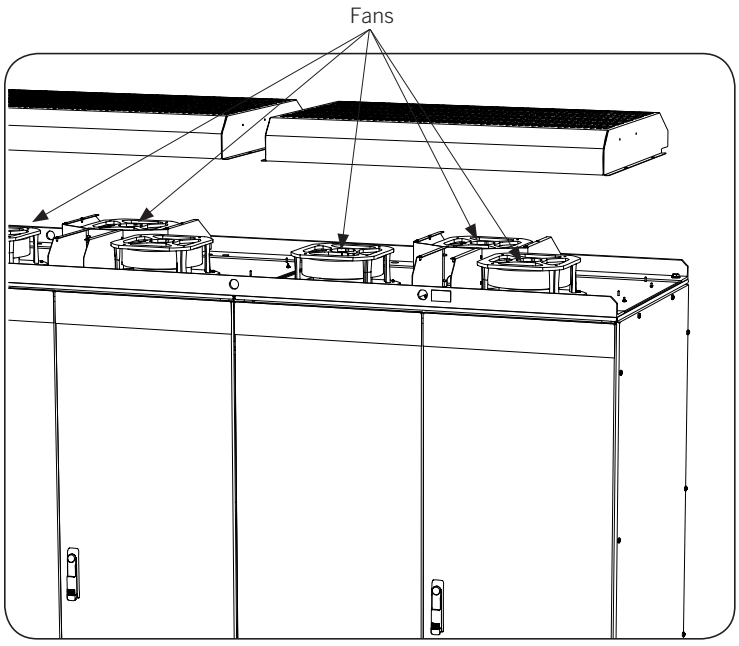
* optional.

2.7.2. Power modules

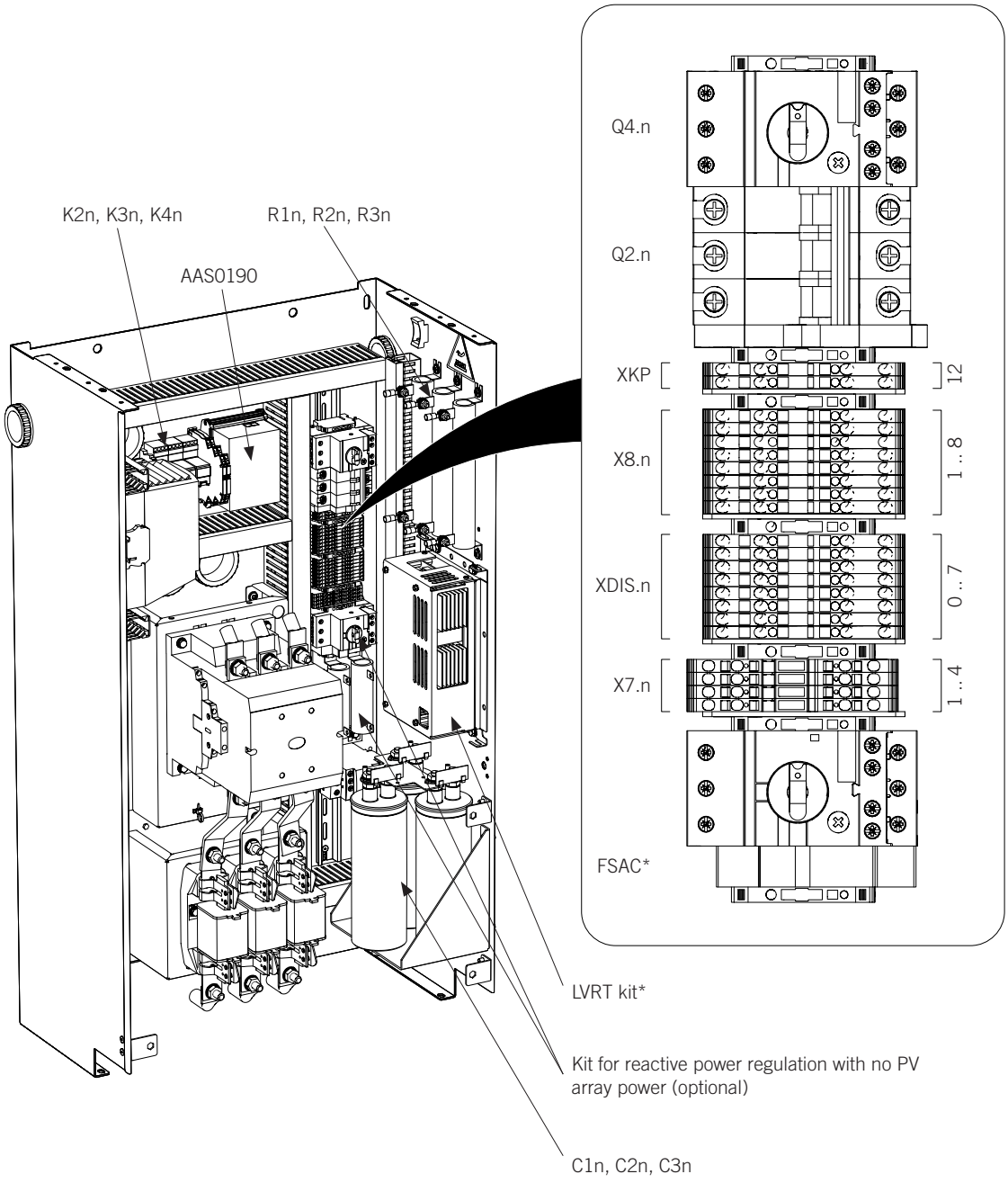
Overview of modules 1 and 2

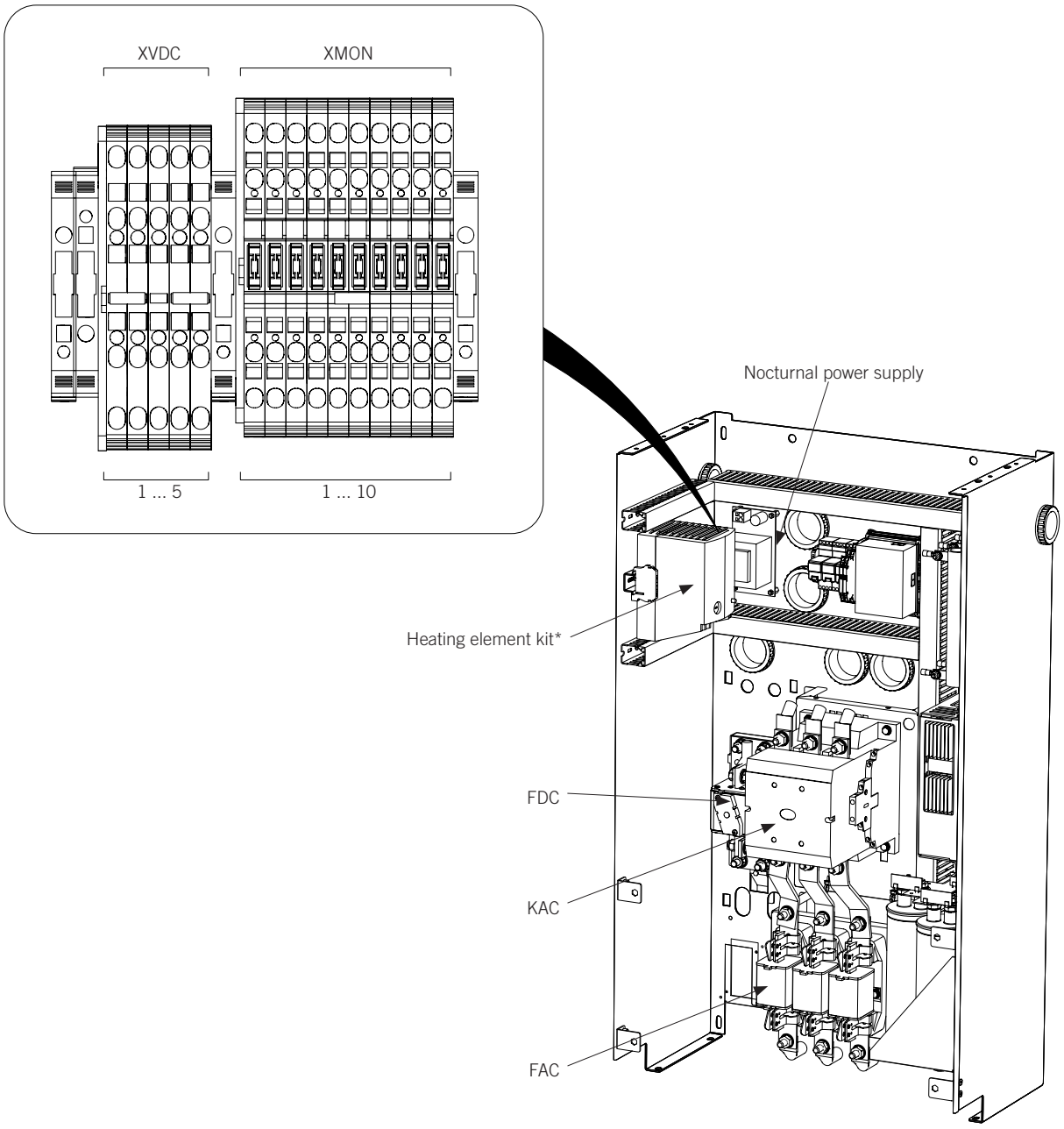



L1n
LDCn
L2n
RDCn


Fans

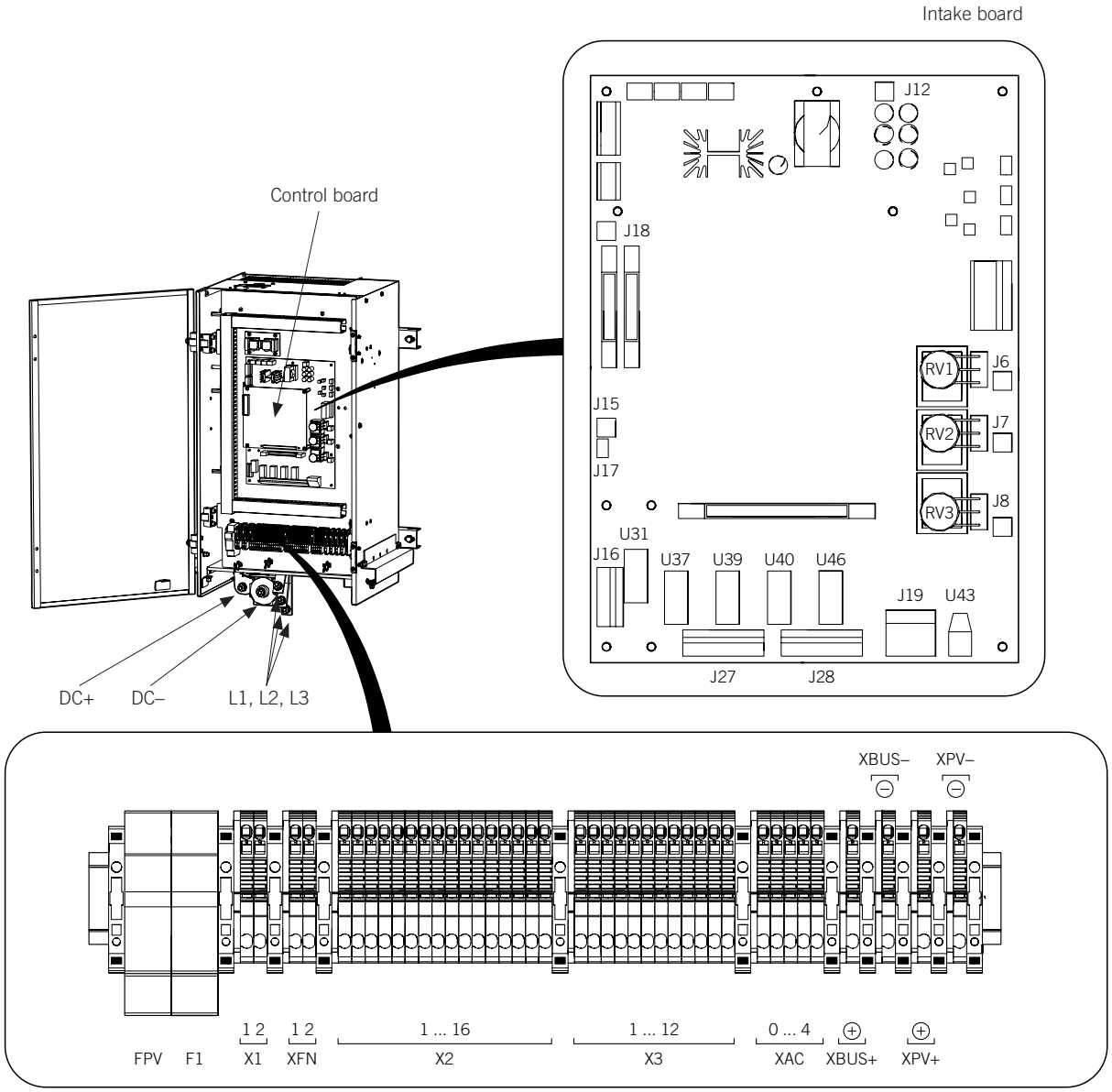
Mounting plate




XVDC
XMON
1 ... 5
1 ... 10
Nocturnal power supply
Heating element kit*
FDC
KAC
FAC

* optional.

Electronics block



2.8. Compliance with regulations

These units can incorporate kits making it adaptable to the regulations for all European countries and countries in other continents, complying with each country's medium voltage regulations.

For projects in the United States or Canada, Ingeteam has the INGECON SUN U families, which have their own manual.

2.8.1. CE marking

CE marking is mandatory for the sale of any product within the European Union, without prejudice to standards or laws. These units have the CE marking by reason of their compliance with the following directives:

- Low Voltage Directive *2006/95/EC.*
- Electromagnetic Compatibility Directive *2004/108/EC*.

To comply with each directive, compliance with the parts applicable to our units of the appropriate harmonised standards is sufficient.

Low Voltage Directive

These units comply with this directive by means of compliance with the applicable parts of harmonised standard *EN 50178 Electronic equipment for use in power installations*.

Electromagnetic Compatibility Directive

These units comply with this directive by means of compliance with the applicable parts of harmonised standards:

- *EN 61000-6-2 Electromagnetic Compatibility*. Part 6-2: Generic standards - Immunity for industrial environments.
- *EN 61000-6-4 Electromagnetic Compatibility*. Part 6-4: Generic standards - Emission for industrial environments.

Compliance with these standards calls for compliance with limits and procedures in other standards of the same series.

2.9. EMC requirements

These units are equipped with the necessary filtering elements to comply with EMC requirements for industrial applications in order to prevent disturbances in other equipment outside the installation.

All of these units are connected to the grid through a low to medium voltage transformer. This transformer gives the unit galvanic isolation that affects its good performance in terms of noise emission (see Section *"7.7.1. Grid connection transformer"*). This is why:

Any auxiliary element must be connected to the low voltage network powering the units via a galvanic isolation transformer (see Section *"7.7.2. Auxiliary transformer"*).

2.10. Protection class

These units meet IP20 degree of protection against external agents, and must not be installed outdoors.

2.11. Contamination class

The pollution class for which the units have been designed is grade 3.

Suitable measures should be taken to provide dust-free air of sufficient quality in the vicinity of the inverter.

2.12. Acoustic contamination

When on, the inverter generates a buzzing sound.

Do not place it in an occupied room, or on light supports which might amplify this buzz. The mounting surface must be firm and appropriate for the weight of the unit.

2.13. Characteristics of the electrical installation

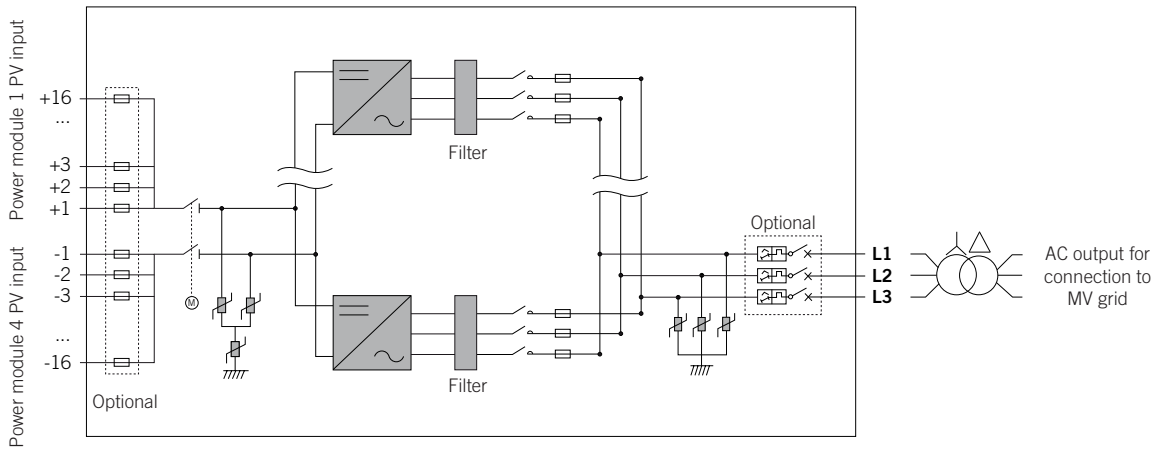
These units are designed for connection to a dedicated network with an IT-type neutral connection scheme. The IT system neutral must be connected as a reference point.

An IT scheme has no directly grounded feed point.

In this system, the resulting intensity of a first phase against mass or phase against ground fault is sufficiently low as to not cause the appearance of dangerous contact voltages.

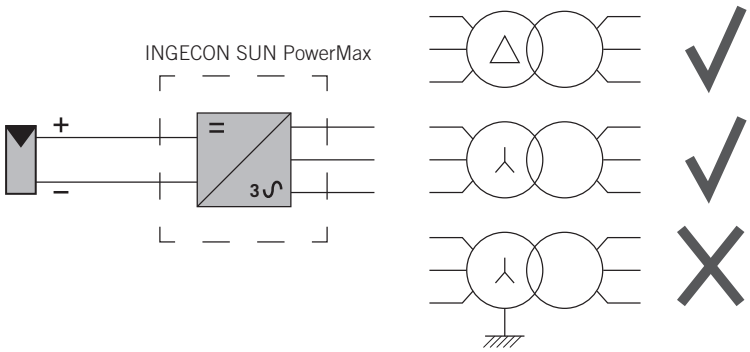
The photovoltaic park must be installed, insulated from the earth in a configuration called *floating* to assure protection against direct and indirect contacts. If requiring grounding for any part of the installation´s DC circuit, the equipment must be equipped with the *grounding Kit*. If selecting this kit, see the installation and operating manual.

2.14. Electrical diagram of the unit



2.15. Electrical diagram of the system

The configuration of the high voltage winding of the grid connection transformer does not affect the behaviour of the unit.



Ingeteam recommends using a transformer with Dyn11 connection.

Whenever a transformer is used with star connection on the Low Voltage side, it will be necessary to connect the neutral as intake reference, as specified in Section *"7.7. Requirements for transformers"*.

2.16. Cooling system

These units have cooling fans on top of each power module. These fans start up for a few seconds each time the inverter is connected to the mains and is about to inject power. This procedure makes it possible to easily check proper operation.

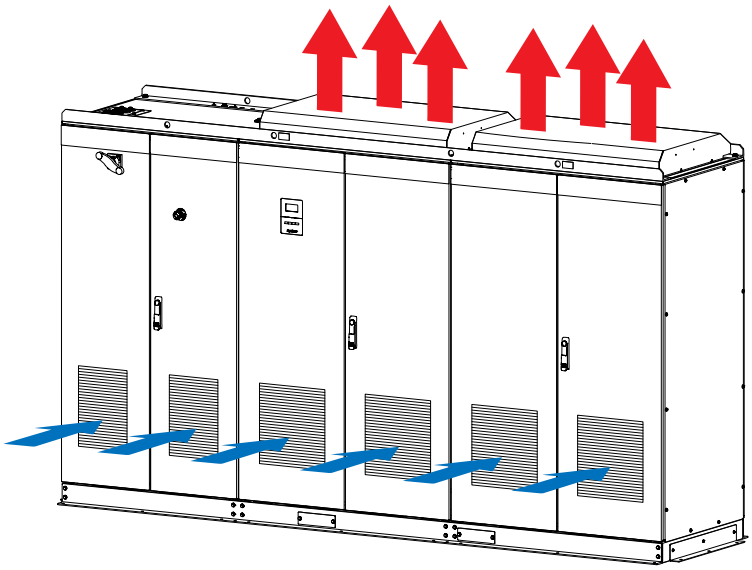
The fans require different air flow for cooling the electronics, depending on the number of power modules in the unit.

The cooling requirements and necessary flow rate are specified in Section *"7.5. Cooling"*.

The useful life of the fans is 8 years, so they must be replaced after this time even if they seem to be functioning normally.

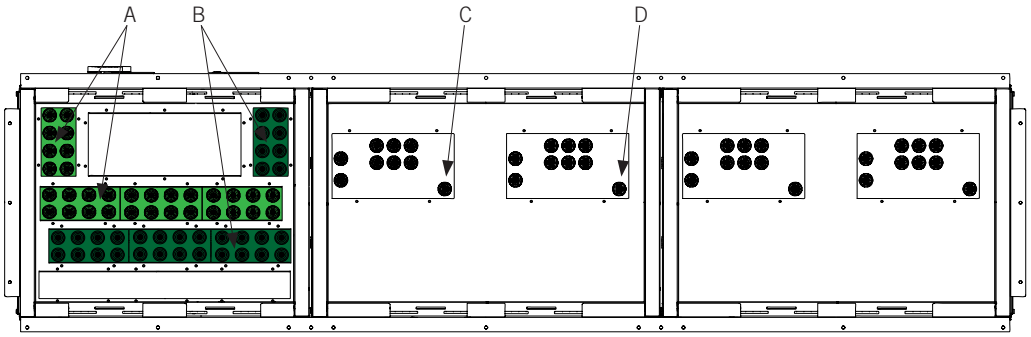
Refer to Section *"18.7. Cooling system"* that explains the replacement of fans.

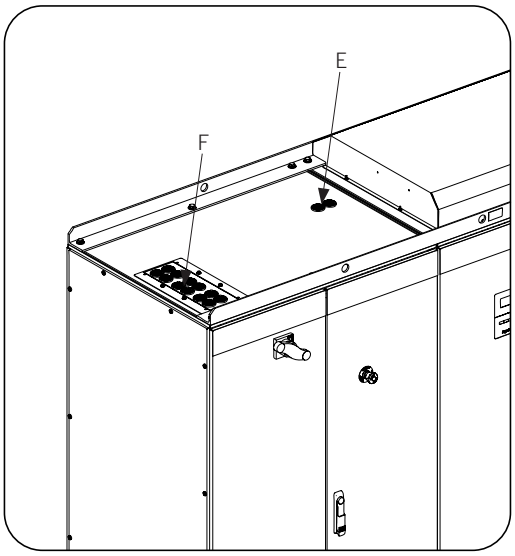
These units include monitoring of the correct operation of the fans. The malfunctioning of one or more fans will cause the unit to stop and go into fatal error status. For further information consult Section *"19. Troubleshooting"*.



2.17. Description of cable inlets

All cables needed for operating and grounding the unit must be entered via the bottom and top of the DCAC supply module.





A. Access to DC +.

B. Access to DC –.

C. Access to auxiliaries.

D. Access to XCOM.

E. Access to communications, intake and auxiliary neutral.

F. AC output.

3. Safety

This section describes the safety warnings and the Personal Protective Equipment and symbols used in the unit.

3.1. Safety conditions

General warnings

The operations described in the manual may be performed only by qualified personnel.

The status of qualified personnel referred to in this manual will be, as a minimum, that which meets all the standards, regulations and laws regarding safety applicable to the tasks of installing and operating this unit.

The responsibility for designating qualified personnel will always fall to the company to which the personnel belong. It is necessary to decide which workers are suitable or not for carrying out specific work to preserve their safety at the same time as complying with occupational safety legislation.

These companies are responsible for providing appropriate training in electrical equipment to their personnel and for familiarising them with the contents of this manual.

All applicable safety-related legislation for electrical work must be complied with. Danger of electric shock.

Compliance with the safety instructions set out in this manual or in the suggested legislation does not imply exemption from other specific standards for the installation, place, country or other circumstances that affect the inverter.

The set of conditions listed throughout this document should be considered as minimum requirements. It is always preferable to shut off the main power supply. There may be faults in the installation that cause the unwanted return of voltage. Danger of electric shock.

Opening the door of the housing does not imply there is no voltage inside.

The risk of electric shock exists even after disconnecting from the grid, the PV array and the auxiliary supply.

Only qualified personnel may open it, following the instructions in this manual.

According to basic safety standards, all the equipment must be suitable to protect exposed workers against the risk of direct and indirect contact. In any case the electrical parts of the work equipment must comply with the provisions of the corresponding specific regulations.

According to basic safety standards, the electrical installation shall not entail a fire or explosion risk. Workers must be duly protected against the risk of accidents caused by direct or indirect contact. The electrical installation and protection devices must take into account the voltage, the external conditions and the competence of persons who have access to parts of the installation.

Class III - 1000-Volt measuring instruments must be used for checking for the absence of voltage.

Carry out all control and handling without voltage.

As a minimum security measure in this operation, you should always follow the so-called **5 golden rules**:

1. Disconnect
2. Prevent any possible resupply
3. Check there is no voltage
4. Ground and short circuit the equipment
5. Protect from live elements, if any, and put up safety signs around the work zone.

Until these five steps are completed, the work area cannot be considered voltage-free and any work performed will be considered to be work on live equipment.

Ingeteam accepts no liability for any damages caused by improper use of the equipment. Any work carried out on any equipment which implies a modification of the original electrical arrangements must be proposed in advance to Ingeteam. These must be studied and approved by Ingeteam.

It is obligatory to provide the necessary measures to prevent any person from outside the installation from approaching or handling the equipment.

It is strictly forbidden to gain access to the inside of the electrical panel through any other point than the access cover provided for the purpose. Always access when the unit is voltage-free.

These instructions must be easily accessible close to the unit and located within reach of all users.

Before installation and start-up, please read these safety instructions and warnings carefully as well as all the warning notices located on the unit. Ensure that all the notices are perfectly legible and that those which are damaged or have disappeared are restored.

Protection against direct contact is by means of the housing.

The unit has been tested according to the applicable regulations to comply with the safety requirements, the values for insulation clearances and leakage paths for the voltages used.

Potential hazards for people

DANGER: Electric Shock.

The equipment may remain charged after disconnecting the PV array, mains power and auxiliary power.

Carefully follow the mandatory steps in the manual for removing the voltage.

DANGER: explosion.

There is a very low risk of explosion in very specific cases of malfunction.

The casing will protect people and property from the explosion only if it is correctly closed.

DANGER: Crushing and joint injuries.

Always follow the indications in the manual on moving and placing the unit.

The weight of this unit can cause serious injury and even death if not handled correctly.

DANGER: High temperature.

The flow of outlet air can reach high temperatures which can cause injury to anybody exposed to it.

Potential hazards for the equipment

CAUTION: Cooling.

The unit requires particle-free air flow while it is operating.

Keeping the unit in the upright position and the inlets free of obstacles is essential for this air flow to reach the inside.

CAUTION: connections.

After all duly authorised handling, check that the equipment is ready to start operation. Only after this can you connect it following the instructions in the manual.

Do not touch boards or electronic components. The more sensitive components can be damaged or destroyed by static electricity.

Do not disconnect or connect any of the terminals while the unit is operating. Disconnect and check for absence of voltage first.

3.2. Personal Protective Equipment

When working on the unit, use the following safety equipment recommended by Ingeteam as a minimum.

Name	Explanation
Safety shoes	In compliance with standard *UNE-EN-ISO 20345:2012*
Helmet	In compliance with standard *EN 397:1995*
Helmet with face shield	In compliance with standard *UNE-EN 166:2002*, provided there are elements with directly accessible voltage.
Working clothes	Close-fitting, non-flammable, 100% cotton
Dielectric gloves	In compliance with standard *EN 60903:2005*
Anti-impact glasses	Use of anti-impact glasses when accessing the fan area.

Tools and/or equipment used in live work must have at least class III-1000 Volts insulation.

Should the country's regulations demand another kind of personal protection, the equipment recommended by Ingeteam should be appropriately supplemented.

3.3. Symbols on the inverters

Connection from cable and phase 1 terminal.

Connection from cable and phase 2 terminal.

Connection from cable and phase 3 terminal.

DC outlet.

AC outlet.

Ground terminal.

Grounded points.

On

Off

4. Equipment reception

4.1. Packaging symbols

Bear in mind the following symbols present on the packaging of the unit:

Move transport packaging with this side up.

Do not use sharp tools to open the shipping packaging.

Prevent the unit from becoming wet.

Do not place anything on top of the shipping packaging.

The contents of the shipping container are fragile.

Keep the unit in its packaging until immediately before installation. Maintain the unit **upright** at all times.

4.2. Equipment identification

The serial number of the equipment is its unique identifier. You must quote this number in any communication with Ingeteam.

In addition to the unit serial number, each electronics block has its own serial number.

The ratings plate of the electronics blocks can be found on a prominent place inside the module.

4.3. Transport damage

If the unit has been damaged during transport, proceed as follows:

1. Do not proceed with the installation.
2. Notify the distributor immediately within 5 days of receipt of the unit.

If ultimately the unit has to be returned to the manufacturer, the original packaging must be used.

5. Storage

Failure to follow the instructions provided in this section may lead to damage to the unit.

Ingeteam accepts no liability for damage resulting from the failure to follow these instructions.

If the unit is not installed immediately after reception, the following points should be taken into account in order to avoid damage:

- The package must be stored in the vertical position.
- Keep the unit free of dirt (dust, shavings, grease, etc.) and away from rodents.
- Keep it away from water splashes, welding sparks, etc.
- Cover the unit with a breathable protective material in order to prevent condensation due to ambient humidity.
- Units in storage must not be subjected to weather conditions other than those indicated in Section *"7.3. Environmental conditions"*.
- It is very important to protect the unit from chemical products which can cause corrosion, as well as from salty atmospheres.
- Do not store the unit outdoors.

5.1. Conservation

In order to permit correct conservation of the units, you must not remove them from their original packaging until it is time to install them.

In case of prolonged storage, the use of dry places avoiding, as far as possible, sharp changes in temperature is recommended.

Deterioration of the packaging (tears, holes, etc.) prevents the units from being kept in optimum conditions before installation. Ingeteam accepts no liability in the case of failing to observe this condition.

5.2. Unpacking

Correct handling of the units is vitally important in order to:

- Prevent damage to the packaging which enables them to be kept in optimum condition from shipping until they are installed.
- Avoid knocks and / or falls which may harm the mechanical characteristics of the units, e.g. cause incorrect closure of doors, loss of protection rating, etc.
- Avoid, as far as possible, vibrations which may cause subsequent malfunction.

If you observe any anomaly, please contact Ingeteam immediately.

Separating the packaging

You can deliver all the packaging to a non-hazardous waste management company.

In any event, each part of the packaging may be recycled as follows:

- Plastic (polystyrene, bag and bubble wrap): the appropriate container.
- Cardboard: the appropriate container.

6. Equipment transport

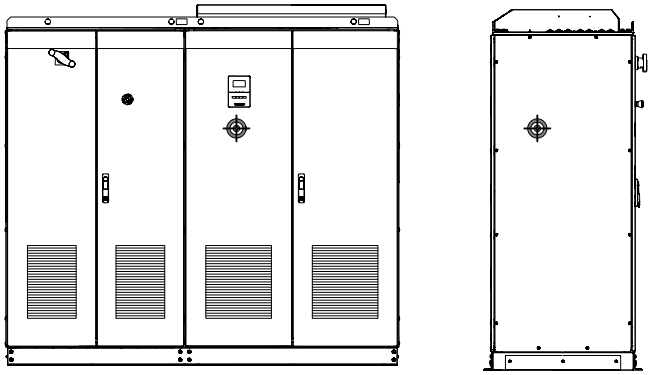
The unit must be protected, during transport, from mechanical knocks, vibrations, water splashes (rain) and any other product or situation which may damage it or alter its behaviour.

Failure to observe these instructions may lead to loss of warranty on the product, for which Ingeteam is not responsible.

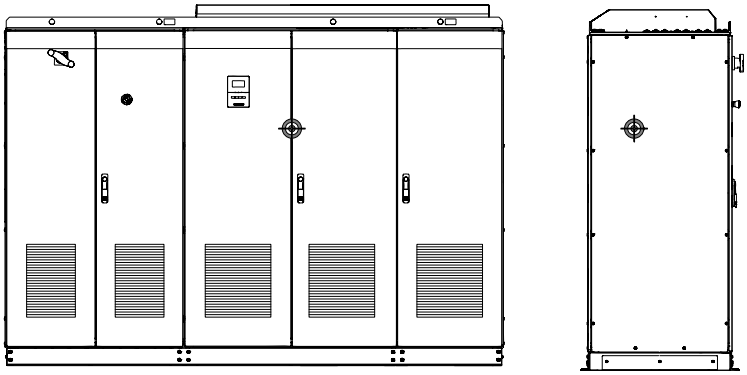
Ingeteam recommends transporting the unpacked equipment using a crane wherever possible.

6.1. Centre of gravity

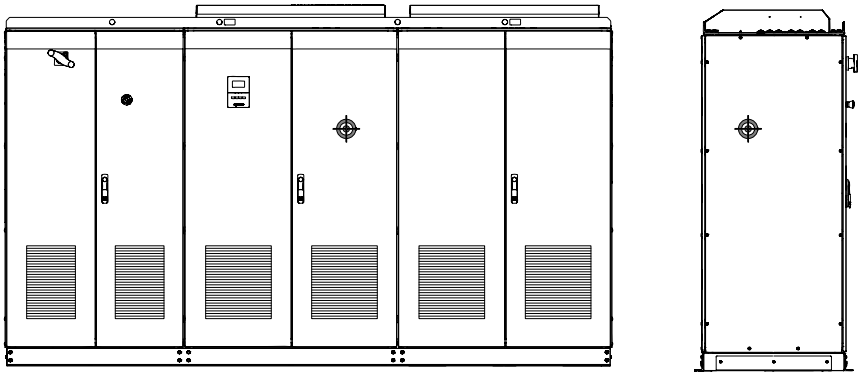
Bear in mind the centre of gravity of the unit whenever it is moved. Then specify the approximate location of the centre of gravity depending on the number of power modules.



Centre of gravity for units with 2 power modules



Centre of gravity for units with 3 power modules



Centre of gravity for units with 4 power modules

6.2. Transport using a forklift truck

Transporting the packed equipment

It is recommended to move the unit while in its packaging.

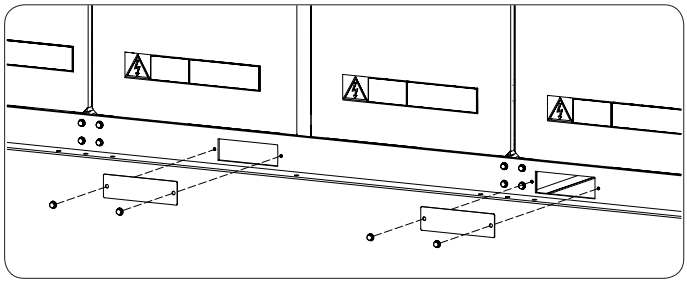
At least the following requirements should be observed:

1. Place the packed unit bearing in mind the centre of gravity of the unit whenever it is moved.
2. Try to locate it as close as possible to the connection between the forks and the chassis.
3. Ensure that the forks are perfectly level to avoid overturning the unit.
4. Transport the unit to the location where you wish to install it and unload it using the reverse process.
5. In any case, observe the instructions in the forklift truck's user manual.

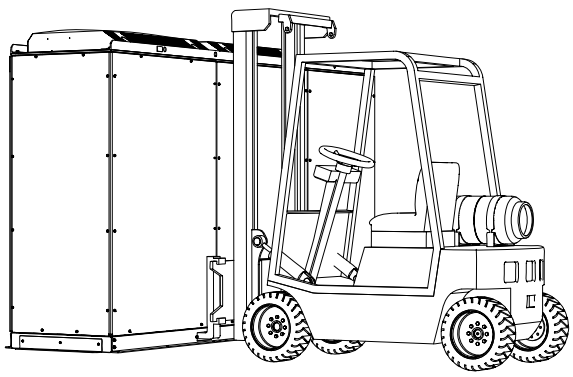
Transporting the unpacked equipment

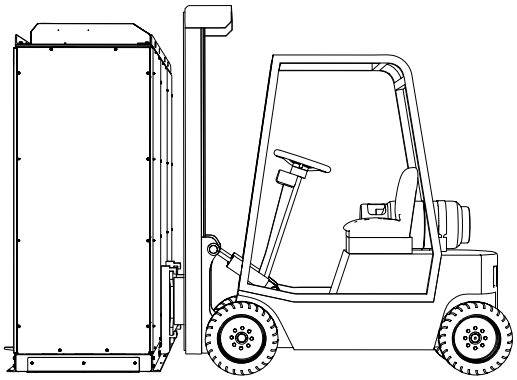
When moving the unpacked unit at least follow the following requirements:

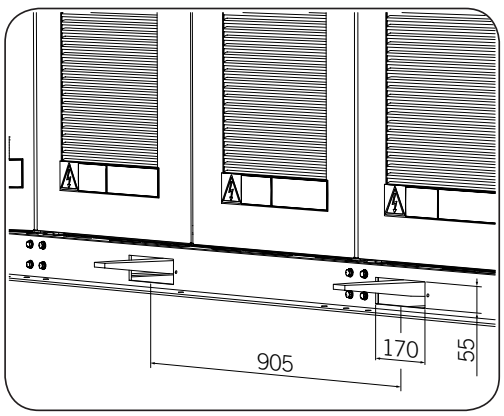
1. Remove the front and rear protective covers designed to block the holes for the forks of the forklift truck.



2. Insert the forks into the holes provided. **The forks should be completely horizontal throughout the transportation process**. Special care must be taken to keep the unit completely vertical during transportation in order to avoid damaging the protruding parts of the unit with the forklift truck lifting frame.







3. Try to place the unit as close as possible to the connection between the forks and the chassis without damaging the protruding parts of the units with the forklift truck lifting frame.
4. Ensure that the forks are perfectly level to avoid overturning the unit.
5. Slowly transport the unit to the location where you wish to install it and unload it using the reverse process. Beware of uneven terrain to prevent the unit from falling over.
6. In any case, observe the instructions in the forklift truck's user manual.

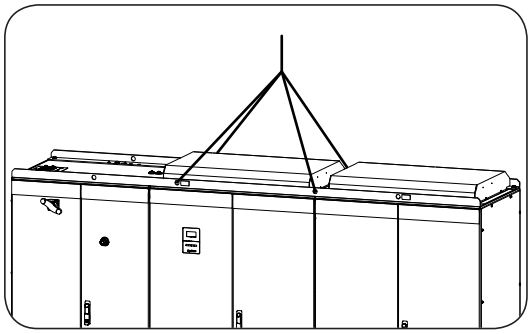
6.3. Transport using a crane

When lifting by crane, the lifting beams fitted to the top of the unit should be used, as shown below.

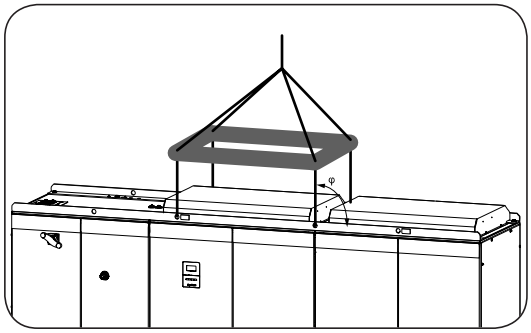
Ensure that the load is distributed evenly between the holes on the lifting beam.

Ensure that the load is distributed evenly along the lifting beam.

Tie individual cables, chains or ropes to each of the holes, making sure the angle is less than or equal to 45° to vertical and ensuring that the cables are as vertical as possible.



It is always advisable to use a load frame as in the adjoining figure for a proper distribution of the loads, bearing in mind that the angle φ should be equal to 90°.



7. Preparation for installing the unit

When deciding the location of the unit and planning your installation, you must follow a set of guidelines based on the specifications of the unit.

This chapter summarises the guidelines and details the external elements needed for correct operation of the unit.

7.1. General requirements for installation

- The work space must be suitable for maintenance tasks according to current regulations. There must be 1.5 m of free space around the unit.
- The external connection devices must be suitable and sufficiently close as set forth in current regulations.
- The feed cables must be of the appropriate gauge for the maximum current.
- Special care must be taken to ensure that there are no external elements near the air inlets and outlets that obstruct proper cooling of the unit.
- This manual is not intended to supersede any laws, regulations or codes applicable to the installation or the use of the unit, whether local, state or national, including electrical safety codes.
- Installations must be in accordance with laws, regulations, codes and standards applicable in the jurisdiction of the location. Ingeteam accepts no liability for the compliance or non-compliance with these laws, regulations, codes and standards.
- The unit contains no user-serviceable parts.
- Before installing or using the unit, read all the instructions and warnings in this manual.
- Before connecting the unit to the grid, contact the power company. This connection can only be made by qualified personnel.
- The wiring of the unit may only be executed by qualified personnel.

7.2. Environment

- Place the units in a place which is accessible for installation and maintenance work and which permits use of the keyboard and the reading of the front indicator LEDs.
- The air vents and part of the module close to them can reach high temperatures. Do not place any material nearby which is sensitive to high air temperatures.
- Avoid corrosive environments that may affect the proper operation of the inverter.
- Never place any object on top of the unit.
- Do not install the unit outdoors.
- Ingeteam recommends that the wind direction should favour, as far as possible, the cooling of the unit.

7.3. Environmental conditions

Environmental conditions must be taken into account when choosing the location of the unit.

Environmental conditions	
Minimum temperature	–20 ºC
Minimum surrounding air temperature	–20 ºC
Maximum surrounding air temperature	60 ºC
Maximum relative humidity without condensation	95%

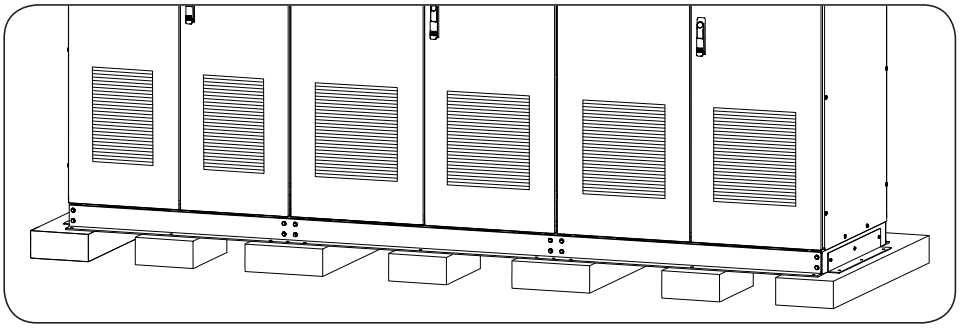
It should be borne in mind that moderate condensation may occasionally occur as a consequence of temperature variations. For this reason, apart from the unit's own protection, it is necessary to monitor these units once they have been started up on sites where the conditions described above are not expected to be present.

In the event of condensation, never apply voltage to the unit. To remove condensation apply a flow of hot air at a maximum temperature of 60 °C.

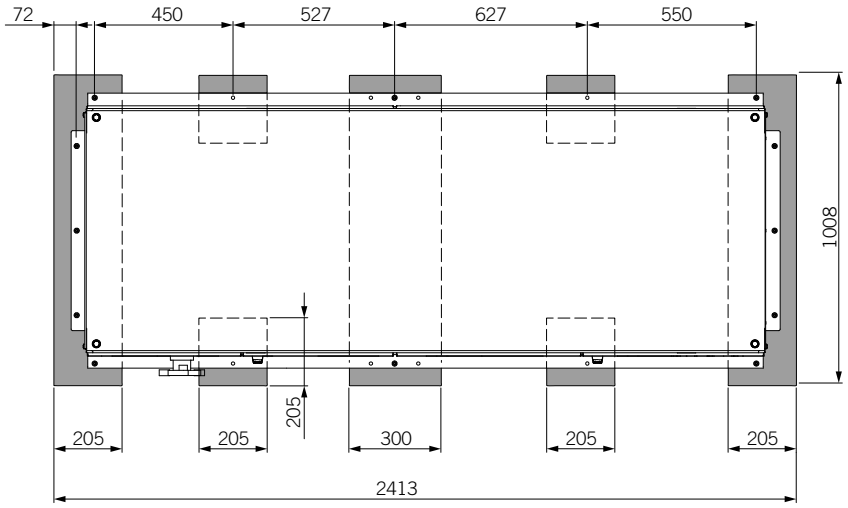
7.4. Fixing surface area

Due to the units' heavy weight, the ground on which it rests should be firm and completely horizontal and level.

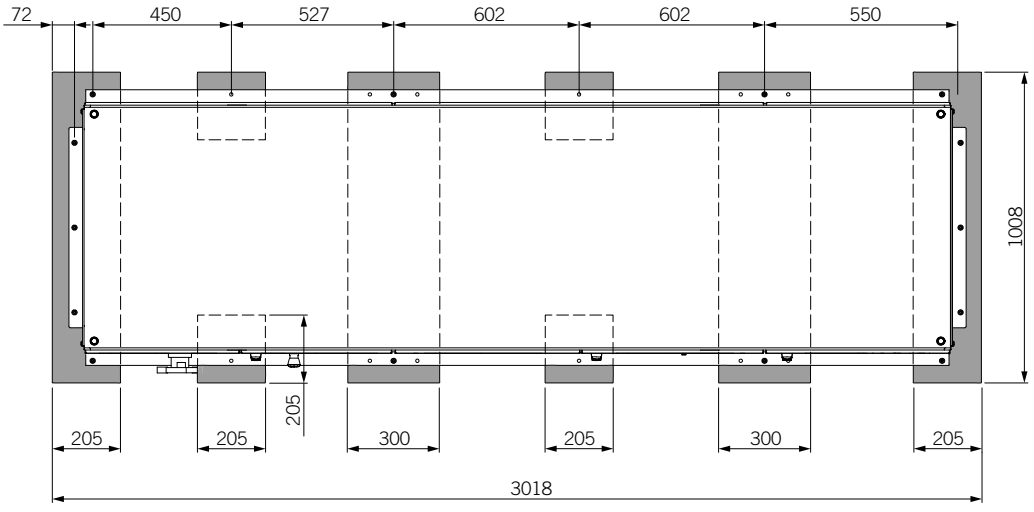
The minimum supports for each unit are specified below.



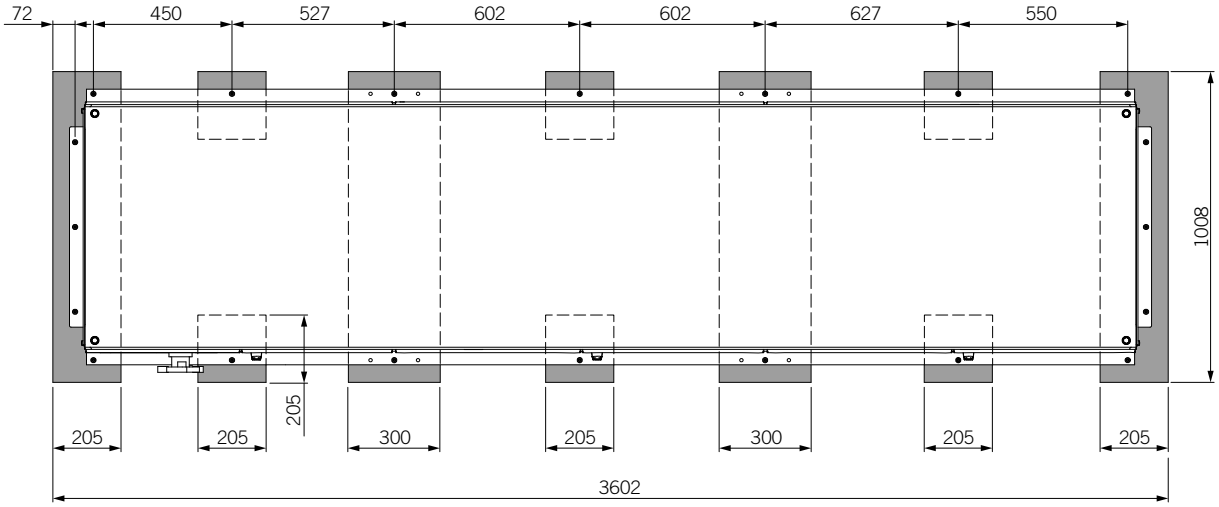
Units with 2 power modules



Units with 3 power modules

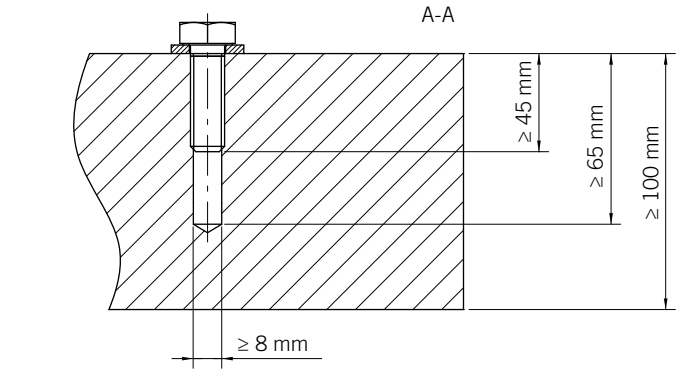


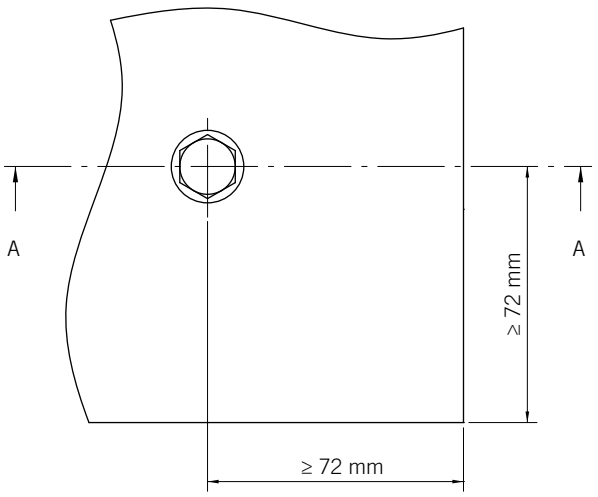
Units with 4 power modules



The following stipulations must be followed when choosing the place where the unit is to be bolted in:

- Minimum distance from the centre of the bore to the edge of the concrete pad: 72 mm.
- Diameter of the hole drilled in the concrete pad: 8 mm.
- Minimum depth of the hole drilled in the concrete pad: 65 mm.
- Minimum thickness of the concrete pad: 100 mm.
- Minimum depth of anchoring bolt: 45 mm.





7.5. Cooling

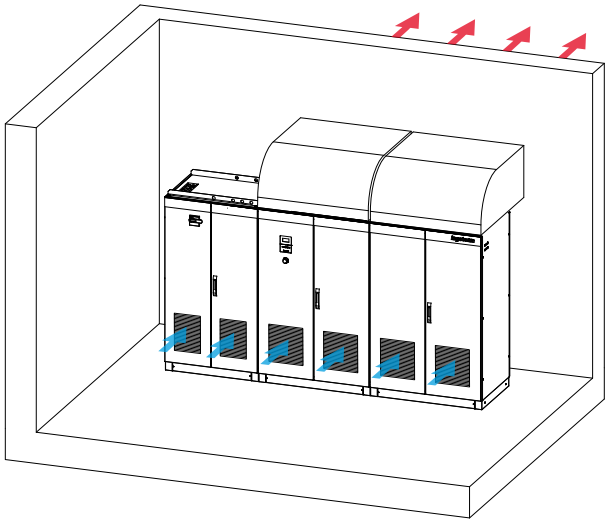
These units are designed to be installed in a cabin or enclosed location. Adequate ventilation must be provided and the following requirements met to guarantee proper operation within the whole range of temperatures for which the equipment was designed:

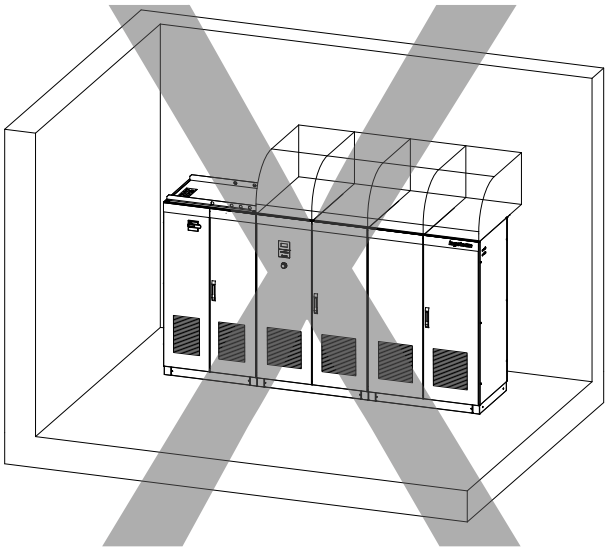
- Ensure the total flow for all the inverter fans. The following table shows the flow rate required by each inverter as a function of the number of power modules.

Number of modules	Air flow rate
2 power modules	2670 m³/h
3 power modules	4640 m³/h
4 power modules	5340 m³/h

  If there is more than one unit inside the cabin or enclosed location, multiply the corresponding value in the table by the number of inverters.

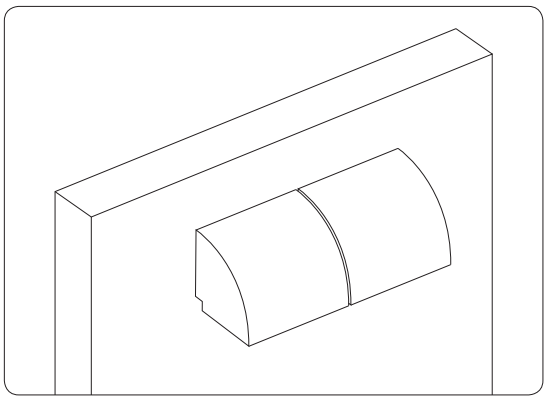
- These inverters have IP20 protection. Therefore, it must be ensured that the air intakes and outlets are protected against water and dust. These units have filters in their intakes, hence the use is recommended in the cabin air intake of a class G3 filter (according to standard *EN 779*.
- For correct cooling appropriate to the filters installed in the unit, air quality must be guaranteed to environmental class 3S2, in accordance with standard *EN 60721-3-3*.
- The entry of air to the cabin or enclosed location must be dimensioned such that the speed to of the air intake is less than 3 m/s.
- Total permissible pressure loss in the cabin ventilation system (inlet grille and filter, air outlet duct, outlet grille and outlet hood) for the total required flow rate will be 100 Pa.
- Ingeteam recommends installing an air outlet duct (plenum) to facilitate the extraction of the hot air generated by unit operation to the outside of the cabin or enclosed location. This plenum must be thermally insulated. If the indicated plenum is installed, it will not be necessary to use additional extractor fans inside the cabin or enclosed location. In the event that there are other heat-generating components in the cabin, consider whether the use of additional fans is necessary. In such a case you must take into account the increase of pressure loss due to the increase in air speed through the intake grids.
- The ventilation duct (plenum) must group all the power modules the unit has, or at least two of them. The plenum for units with two or three power modules must group all the power modules. In four-module units two plenums will be installed, which will group two power modules each. Individual ducts must not be installed for each power module.

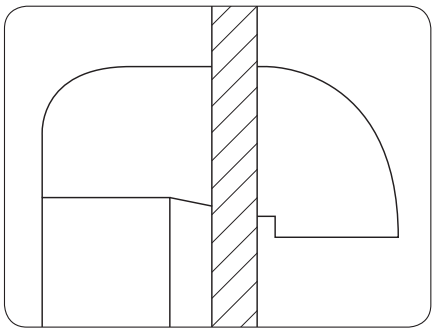




When putting the plenum in place, the installer must make sure that none of the holes made or the fastening bolts used damages the fans located at the top of the inverter, since they can become irreparably damaged and useless. It is also important to make sure that no dirt or dust falls in the roof or fan areas. You are recommended to cover this area with a plastic tarpaulin when making the holes and use a vacuum cleaner to clean the area before putting the plenum in place. Ingeteam shall not be held responsible for damage caused due to perforation of these with a drill or the accumulation of dirt and dust during the installation.

- Install outside outlet grids that prevent the entry of water and dirt.
- The option of installing a hood in the air outlet is suggested to prevent water entry. Similarly, a grille needs to be positioned to prevent animals and other objects from entering. The construction of a plenum with a slight slope towards the outside is recommended to prevent accumulation and entry of water to the unit.





- The maximum temperature rise inside the cabin or enclosed location with respect to the outside temperature must be less than 5 ºC.
- The speed and temperature of the intake air at the power module inlets must be as homogeneous as possible.
- To ensure correct cooling of the unit, the cabin and unit filters must be maintained properly and at the indicated frequency, as specified in Section *"18.7. Cooling system"* in the section on maintenance.

Install the unit so that the air entering for cooling does not come from air expelled by other units or any other heat source.

Do not place any object on top of the unit.

Avoid dropping particles that could enter the unit through the cooling grids.

Facilitate the flow of air entering through the cooling grids.

For more information request document AAV0000IMC03 from Ingeteam.

If you have any queries or suggestions, contact Ingeteam.

7.6. Requirements for DC feed fuses

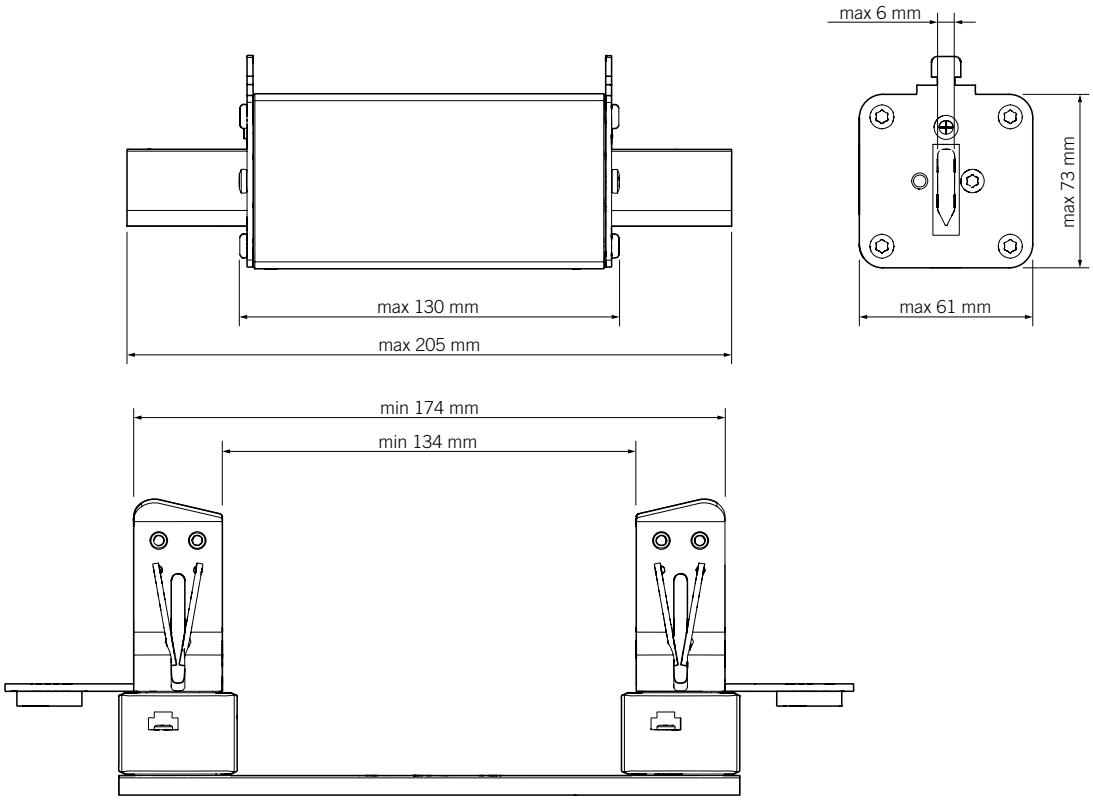
These inverters can be equipped with fuse holders for DC or not, depending on the client's needs. Inverters with fuse holders have between 8 and 32 fuse holders according to the number of modules and the unit configuration.

The fuses to be installed in the bases provided must meet the following specifications.

Electrical specifications

- Rated voltage greater than or equal to 1000 VDC.
- gPV class.
- Rated current of 50 A - 400 A, depending on the features of the unit.

Mechanical specifications



These inverters can be equipped with fuse holders from different manufacturers, that is why in the previous figure they indicate as reference the minimum measures of the fuse holders used.

Approval references

The following fuse references meet the required electrical and mechanical specifications.

Bussmann	Size	Rated current	Rated voltage
PV-63A-01XL	01	63 A	1000 VDC
PV-80A-01XL		80 A	
PV-100A-01XL		100 A	
PV-125A-01XL		125 A	
PV-160A-01XL		160 A	
PV-200A-1XL	1	200 A	
PV-200A-2XL	2	200 A	
PV-250A-2XL		250 A	
PV-315A-2XL		315 A	
PV-350A-3L-B	3	350 A	

Siba		Size	Rated current	Rated voltage
Without an indicator	**With indicator and microswitch adapter**			
20 028 28.50	20 028 29.50	NH1XL	50 A	1100 VDC
20 028 28.63	20 028 29.63		63 A	
20 028 28.80	20 028 29.80		80 A	
20 028 28,100	20 028 29,100		100 A	
20 028 28,125	20 028 29,125		125 A	
20 028 28,150	20 028 29,150		150 A	
20 028 28,160	20 028 29,160		160 A	
20 028 28,175	20 028 29,175		175 A	
20 028 28,200	20 028 29,200		200 A	
20 031 28,200	20 031 29,200	NH3L	200 A	
20 031 28,250	20 031 29,250		250 A	
20 031 28,315	20 031 29,315		315 A	
20 031 28,350	20 031 29,350		350 A	
20 031 28,400	20 031 29,400		400 A	

7.7. Requirements for transformers

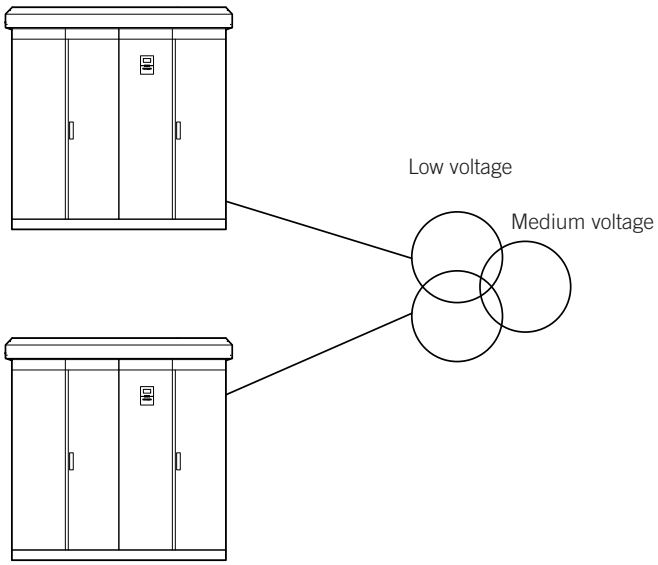
7.7.1. Grid connection transformer

These units must be connected to a transformer with the neutral of the low voltage isolated, thus generating an IT grid.

This section lists the technical specifications of the grid connection transformer which converts the medium or high supply voltage to the operating voltage of the unit.

1. The transformer's power must be greater than the sum of the power ratings of the connected inverters. Take into account the environmental conditions of the site.

2. Units connected to the transformer's low voltage winding must be synchronised. If two or more inverters are connected in parallel to the low voltage side to which the inverter is connected, each will have to be wired individually and galvanically insulated.

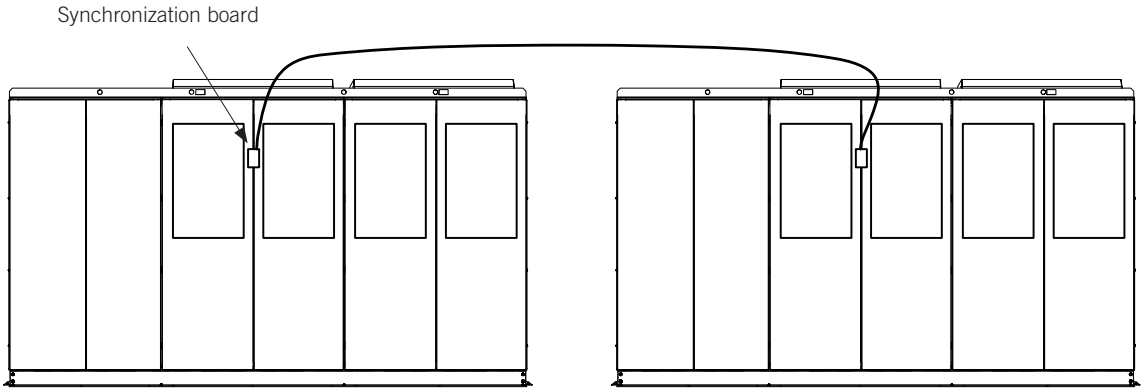


In order to synchronise both units, you must configure one of the units in *Generator* mode and the other as *Repeater*.

In order to configure the unit as *Generator* you must set switch SW1 on the synchronization board indicated in the following figure to position 09.

In order to configure the unit as *Repeater* you must set switch SW1 on the synchronization board indicated in the following figure to position 18.

After completing the configuration, interconnect the synchronization boards of both units, from connector U13 of the board configured as *Generator* to connector U9 of the board configured as *Repeater*.



3. MPPTs connected by these inverters to the same transformer must have the same voltage settings.
4. The Ucc short circuit voltage of the transformer must be equal or less than 6%.
5. We recommend inserting a grounded metal screen between the high voltage winding and low voltage winding.
6. The low voltage winding must withstand pulsating voltage components with dU/dt of 500 V/uS voltage. Because of inverter operation, the voltage between a phase and ground can reach 3/2 of the open circuit voltage of the PV array.
7. We recommend using the Dyn11 connection.
8. The neutral low voltage winding **should not be grounded**. It should be connected to the inverter as a voltage reference (no power transmitted).
9. The connection to the medium voltage network will be the nominal connection point.

10. We advise using transformers equipped with five-point voltage regulators, with the possibility of selecting the following options:

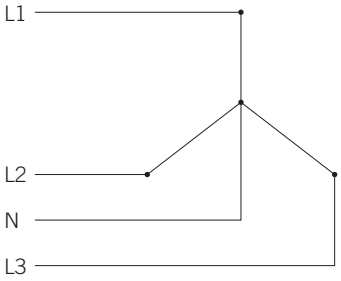
5% 2.5% 0% -2.5% -5%

No electronic equipment may be connected to the power grid. All auxiliary loads must be isolated from the power grid via a galvanically isolated transformer, as shown in the section *"7.7.2. Auxiliary transformer"*.

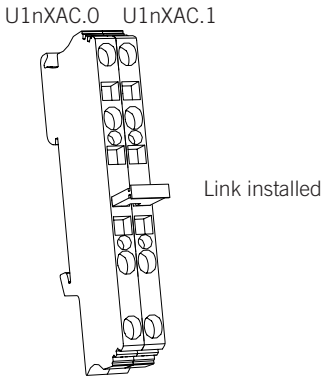
Depending on the type of transformer connection (star or delta), the following points should be borne in mind.

To find the different components listed below, consult Section *"2.7. Location of components"*.

Star electrical connection

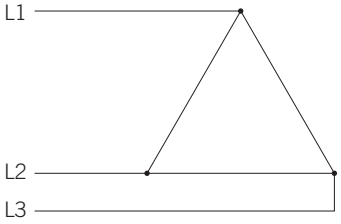


In this case the neutral of the transformer will be connected to dedicated terminal XN of the DCAC supply module. Ensure that the link between terminals U1nXAC.0 and U1nXAC.1 of the electronics block is fitted.



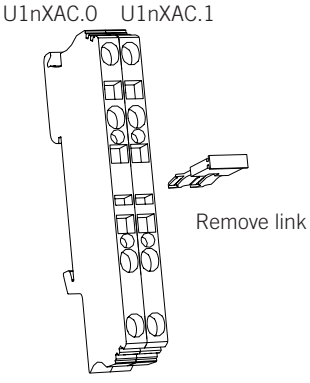
If it is not possible to connect the neutral, the link connecting these terminals must be removed.

Delta electrical connection



In this case no cables will be connected to terminal XN of the DCAC supply module.

Remove the link between terminals U1nXAC.0 and U1nXAC.1 in the electronics block. This link comes installed as standard.



Take into account section *"14.4.3. Connecting the AC neutral"*.

7.7.2. Auxiliary transformer

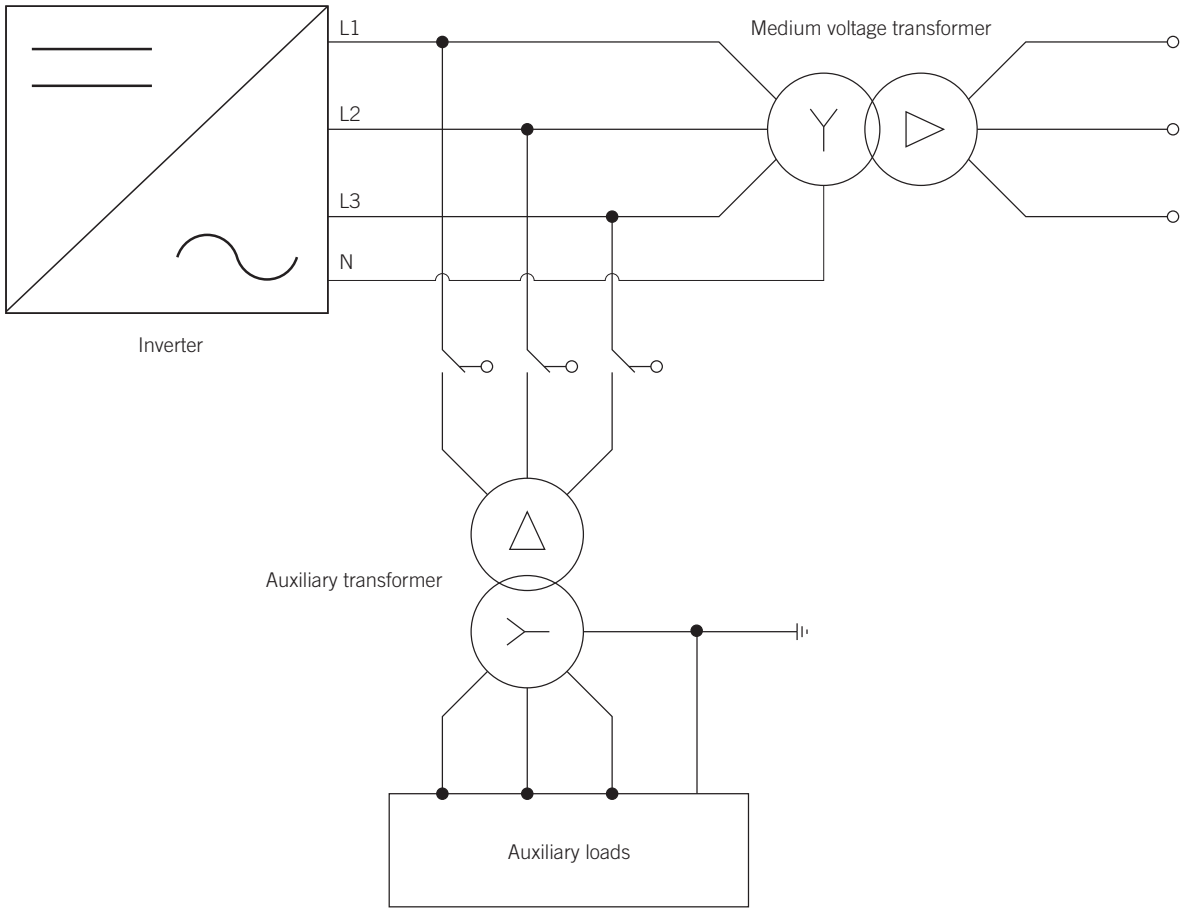
Some unit components such as fans, contactors or power supplies, require auxiliary power to operate. No electronic equipment may be connected to the power grid. All auxiliary loads must be isolated from the power grid via a galvanically isolated transformer.

This is why it is **essential** to install an auxiliary services transformer with galvanic isolation, suitable for the grid with a single phase voltage of 220 V 50/60 Hz.

The Auxiliary service transformer must have galvanic insulation. It is forbidden to use autotransformers or other devices without galvanic isolation to match the grid voltage to the single phase voltage required for the proper operation of the unit.

Ingeteam accepts no liability for any consequences arising from non-compliance with these instructions.

The auxiliary transformer transforms the voltage from the power part of the unit to its control and current part.



The primary circuit is connected to the power input. We recommend installing protection and switching components to protect this transformer.

In the event of using a residual current device between the transformer secondary connected to ground and the auxiliary loads of the unit, said device shall be 300 mA, of industrial use, a selective version and super immune.

The technical requirements of the auxiliary transformer are:

- The transformer's power should be suitable for the loads connected to it, taking the site environmental conditions into account. The minimum values will be as follows:

Number of power modules	Power
2	1500 VA

Number of power modules	Power
3	1800 VA
4	2000 VA

- The power winding must withstand pulsating voltage components with dU/dt of 500 V/uS. Because of inverter operation, the voltage between a phase and ground can reach 3/2 of the open circuit voltage of the PV array.
- Delta connection is advised in the power part and star connection in auxiliary loads.
- The neutral of the auxiliary loads must be connected to ground.

7.8. Measuring equipment connected to the power grid

All measuring devices connected to the power grid (wattmeters, meters, etc.) should be isolated from the grid by voltage transformers, current transformers, etc.

8. Installing the unit

Before installing the unit, the packaging must be removed, taking special care not to damage the housing.

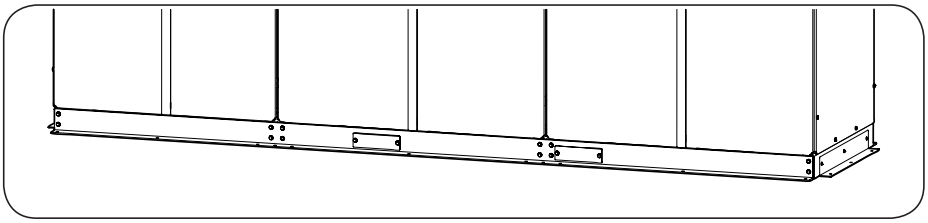
Check that there is no moisture inside the packaging. If there are signs of moisture, the unit must not be installed until you are sure it is completely dry.

All installation operations must comply with current regulations.

8.1. Fixing the unit to the floor

These units feature an optional anchoring system.

The system comprises some plates that bolt the four corners of the base to the concrete pad where the inverter sits.



In order to keep the nuts and bolts of the unit in good condition it is important to make sure there is no dirt or shavings in the threads when screwing them in and apply a suitable lubricant.

Once it has been corrected selected, follow these steps:

1. Mark the fixing points for the plates on the floor.
2. Drill the floor with a recommended drill for the fixture supplied with the fastening plate.
3. Anchor the sheet metal fixing points to the floor.
4. Screw the sheet metal fixing points to the unit.
5. Check that the unit is properly secured.

Once the unit has been mounted in its final position and has been solidly secured, make the electrical connections to it. The order is as follows:

1. Ground connection.
2. Connecting auxiliaries.
3. Connecting the communication accessories.
4. Connection options.
5. DC connection.
6. AC connection.

9. Ground connection

This chapter explains the requirements and process for connecting the ground wiring to the unit.

Read carefully before starting the connection process.

To ensure the safety of persons, the unit must be connected to the ground of the installation.

All unit grounds must be electrically interconnected.

To find the different components listed below, consult Section *"2.7. Location of components"*.

9.1. Safety instructions for the ground connection

Refer to Section *"3. Safety"* and the safety paragraph in this section before operating the equipment.

Make sure there is no voltage present on the unit before carrying out any connections. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

Ingeteam accepts no liability for any damages caused by incorrect connection.

Failing to apply the correct tightening torques to the connection terminals causes a risk of overheating and fire.

In order to keep the nuts and bolts of the unit in good condition it is important to make sure there is no dirt or shavings in the threads when screwing them in and apply a suitable lubricant.

After connecting the ground wiring, **do not switch on the power** until you have made all other connections and the unit has been closed.

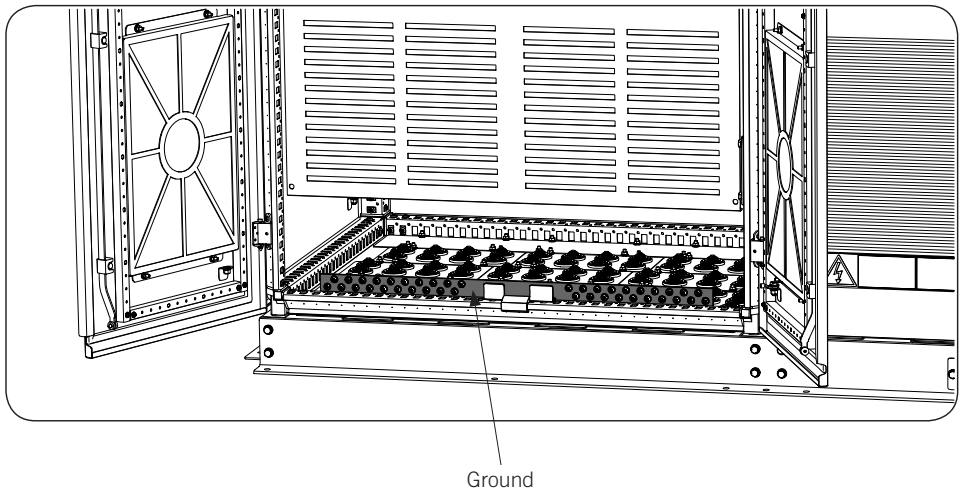
Use the Personal Protective Equipment specified in the section *"3.2. Personal Protective Equipment"*.

9.2. Wiring requirements for the ground connection

- The correct dimensioning of the grounding conductor is the installer's responsibility, depending on the plant specifications and inverter characteristics. The recommended minimum cable size is16 mm^2.
- Only copper and aluminium cables will be used, dimensioned based on inverter and PV plant characteristics.
- The breaking capacity of the circuit breaker installed in the inverter is 50 kA.
- Ingeteam accepts no responsibility for the installation of the inverter in installations with a higher than specified short-circuit current.
- The short-circuit current delivered by the inverter is considerably lower than the specified circuit breaker breaking capacity.

9.3. Connection area

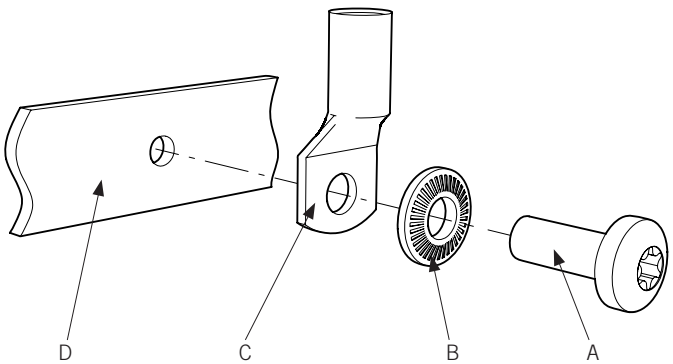
The metal parts of the inverter (equipment ground) are electrically connected to the grounding bar on the front of each cubicle containing the unit electronics. All ground connections must be made to the bar located in the DCAC supply module.



9.4. Ground connection via a terminal

9.4.1. Requirements for the ground connection via a terminal

- For the ground connection, the terminals must be compression terminals with one 6 mm diameter hole.
- Only use the screws and washers provided by Ingeteam upon delivery of the unit.
- Use only tinned copper terminals.
- The torque should be 8 Nm.



A. Torx T30 M6 screws.
B. Washer M6.
C. Terminal.
D. Threaded connection plate.

9.4.2. Making the ground connections via a terminal

1. Strip the cable according to the size of terminal to be used.
2. Crimping the terminal on the cable.
3. Clean the contact surfaces on both the terminal and the connection bar with a clean cloth and ethanol.
4. Connect the terminal to the connection bar using the (previously lubricated) screws and washers supplied by Ingeteam with the unit, respecting the torque specified.
5. Ensure the correct connection of the cable and terminal.

10. Connecting auxiliaries

These units have two AC outlets for supplying certain parts of the unit itself, such as the fans or the 15 V power supply or the motorised DC isolating switch.

This auxiliary voltage must be 230 V between phase and neutral.

This chapter explains the requirements and process for wiring the auxiliary cabling in the unit.

Read carefully before starting the connection process.

To find the different components listed below, consult Section *"2.7. Location of components"*.

10.1. Safety instructions for connecting auxiliary equipment

Refer to Section *"3. Safety"* and the safety paragraph in this section before operating the equipment.

Make sure there is no voltage present on the unit before carrying out any connections. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

Ingeteam accepts no liability for any damages caused by incorrect connection.

After connecting the auxiliary cable, **do not switch the power on** until you have made all other connections and the unit has been closed.

Use the Personal Protective Equipment specified in the section *"3.2. Personal Protective Equipment"*.

10.2. Wiring requirements for connecting auxiliary equipment

- The correct dimensioning of the conductor for auxiliary equipment is the responsibility of the installer. The cable size is 2.5 mm^2.
- Only copper and aluminium cables will be used, dimensioned based on inverter and PV plant characteristics.

10.3. Connection area

Unit general auxiliary voltage

The terminal block for making auxiliary AC connections is X220.OUT located in the rear of the supply module.

The thermomagnetic breaker QAUX protects the auxiliary AC connection.

During connection, make sure that the thermomagnetic circuit breaker is in the OFF position. To check correct operation, return to the ON position. On doing this, the display will light up and the 15 V power supply and electronics of each module will switch on. It is now possible to communicate with the inverter.

Specific auxiliary voltage for the motorised isolating switch

The motorised DC isolating switch has a terminal block with a different supply to the auxiliary voltage terminal block. The connection terminal block for said supply is X220.M, located in the front part of the supply module.

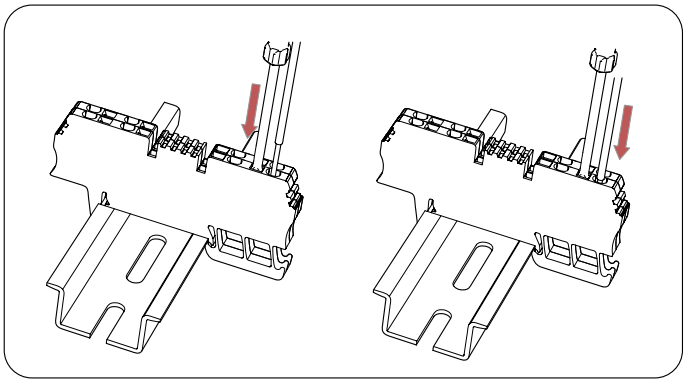
The power supply to the motorised DC isolating switch (X220M) needs to be connected. This power supply is connected separately to the general auxiliary supply to guarantee the independence of the two connections.

The thermomagnetic breaker QM protects the motorised DC isolating switch supply circuit, independent to the thermomagnetic circuit breaker QAUX.

During connection, make sure that this is in the OFF position. To connect the power supply, return to the ON position. The motorised DC isolating switch will not switch to the ON position until all the power modules are on, all the doors are closed and there is also AC supply to the main connection.

10.4. Connection of auxiliaries

1. Strip the cables.
2. Crimp the wire ends according to the wire gauge being used.
3. Open the terminal. The terminals used in this terminal strip are of the clamp type. To insert the cable into the desired position press with a flat head screwdriver, insert the cable and then remove the screwdriver.



11. Connecting the communication accessories

This chapter explains the process for wiring the communications accessories to the unit.

There are several ways to achieve this communication with these units:

- RS-485 (in series).
- Ethernet TCP.
- GSM/GPRS.
- Ethernet RDCom.

To find the different components listed below, consult Section *"2.7. Location of components"*.

See the corresponding communications accessories manual for further information.

Read carefully before starting the connection process.

11.1. Safety instructions for connecting the communications accessories

Refer to Section *"3. Safety"* and the safety paragraph in this section before operating the equipment.

Make sure there is no voltage present on the unit before carrying out any connections. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

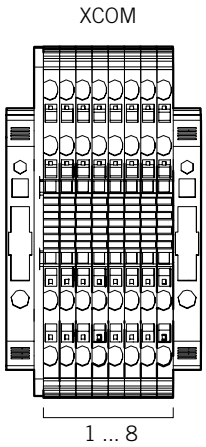
Ingeteam accepts no liability for any damages caused by incorrect connection.

After connecting the communications accessories, **do not switch the power on** until you have made all other connections and the unit has been closed.

Use the Personal Protective Equipment specified in the section *"3.2. Personal Protective Equipment"*.

11.2. Description of the XCOM terminal strip

These units have a communications terminal block located in power module No. 2. It is described in detail below.



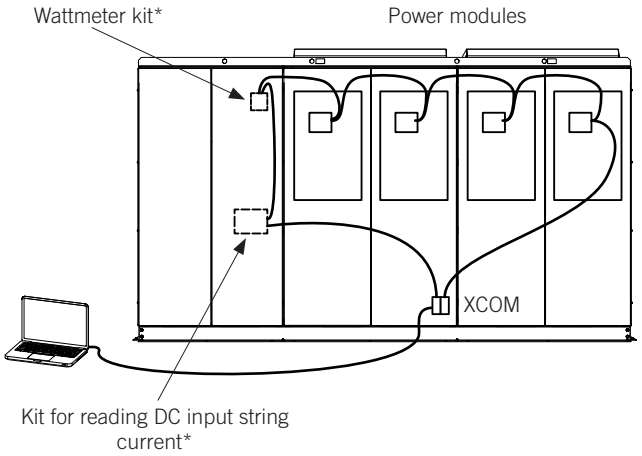
XCOM		
Input	1	RS-485 B (+)
	2	RS-485 A (–)
	3	GND
	4	Ground
Output	5	RS-485 B (+)
	6	RS-485 A (–)
	7	GND
	8	Ground

The unit is provided with a >211 Ohm ferrite rod. It must be connected to the external cable connected to the output from the XCOM terminal block, as close as possible to the latter, turning it around the centre hole twice.

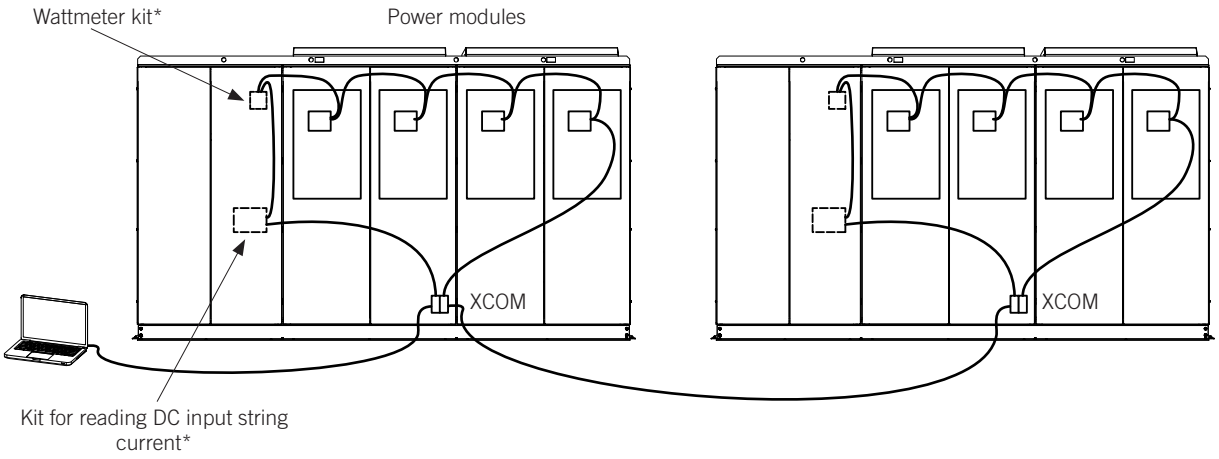
11.3. Communication via RS-485

These units incorporate factory-supplied hardware for communicating via an RS-485 serial line. This hardware is made up of an RS-485 communications board for each power module, already fitted to the control card of each electronics block and connected to communications terminal strip XCOM.

The following diagram shows the connection of one or more units to a computer via RS-485.



RS-485 communication for one inverter



RS-485 communication for several inverters

* optional.

Thanks to this pre-installation, the installer will only need to make the connection via the XCOM communications terminal located in power module 2.

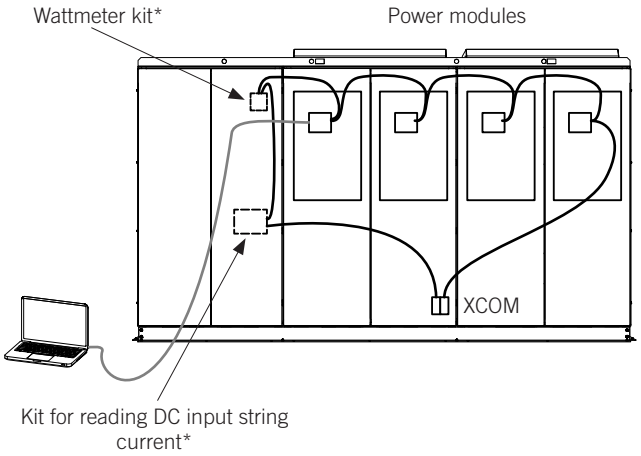
To access this terminal, use the cable openings for power module 2. It is essential for the cable entries to have the same degree of protection as the unit itself.

If the unit has the Wattmeter kit or the Kit for reading DC input string current installed, these will be found in the existing communications network using a different node number to that assigned to the unit.

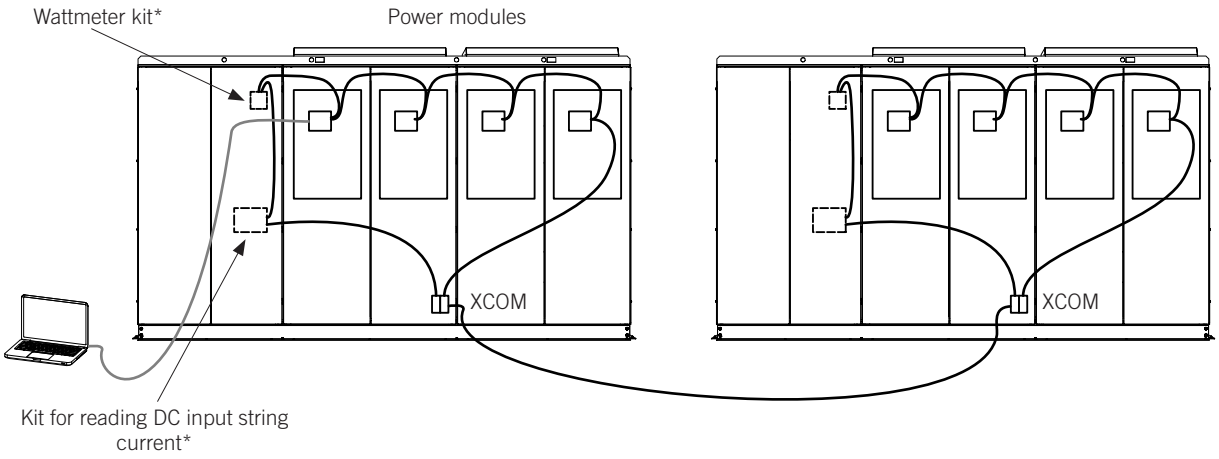
11.4. Ethernet TCP communication

At the request of the installer, inverters may optionally incorporate hardware for communicating via Ethernet TCP.

The following diagram shows the connection of one or more units to a computer via Ethernet TCP.



Ethernet TCP communication for one inverter



Ethernet TCP communication for several inverters

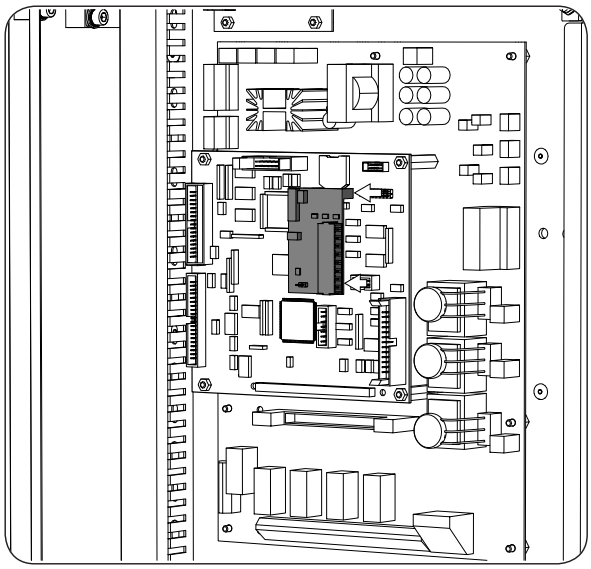
* optional.

Conversion from Ethernet TCP to the communications ring installed in the inverter is made using the Ethernet TCP card, via the RS-485 RTU serial connection.

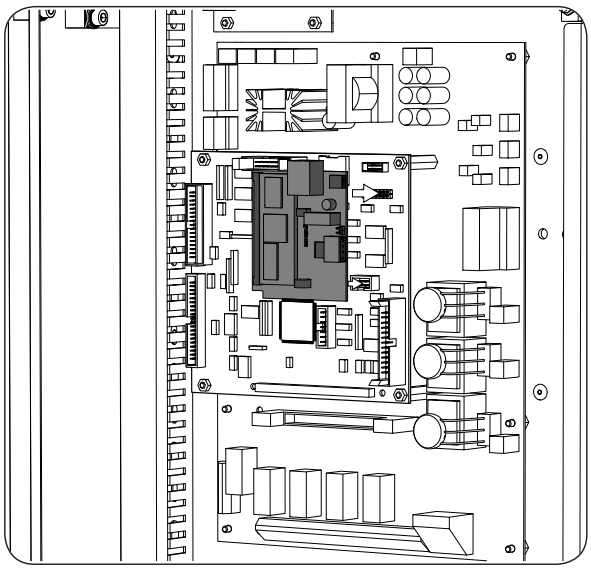
The module connections and possible optional kits installations are made as explained in Section *"11.3. Communication via RS-485"*.

If this communications card is ordered once the unit has been installed, carry out the following steps to install the electronics block of power module number 1:

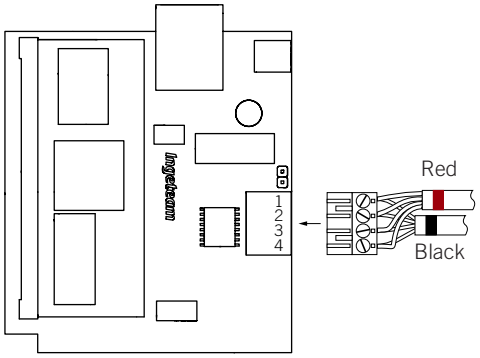
1. Disconnect the RS-485 communications card installed as standard in the unit and disconnect the communications cable from positions 1, 2, 5 and 6 of the aerial connector.



2. Fit the Ethernet TCP communications card to connectors J11 and J12 of the control card as shown in the figure below.



3. Wire the aerial connector that comes with the Ethernet TCP communications card with the cable with the red mark and the cable with the black mark (two wires per pin connector on the wire-to-wire connector). The positions to be wired are as follows:



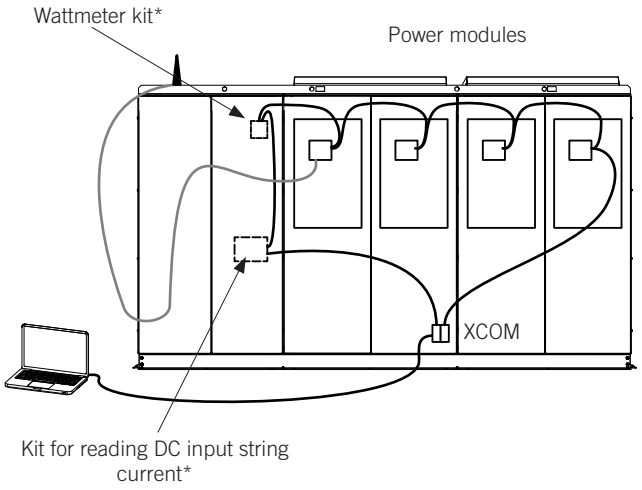
Pin	Cable colour
1	Brown
2	White
3	Green
4	Grid

If the Ethernet TCP communications card is ordered with the unit, the card is provided assembled on the control board and a bag (attached with a tie) containing the Ethernet TCP cable. Connect the cable to the board's Ethernet TCP output and feed it out through the holes in the housing.

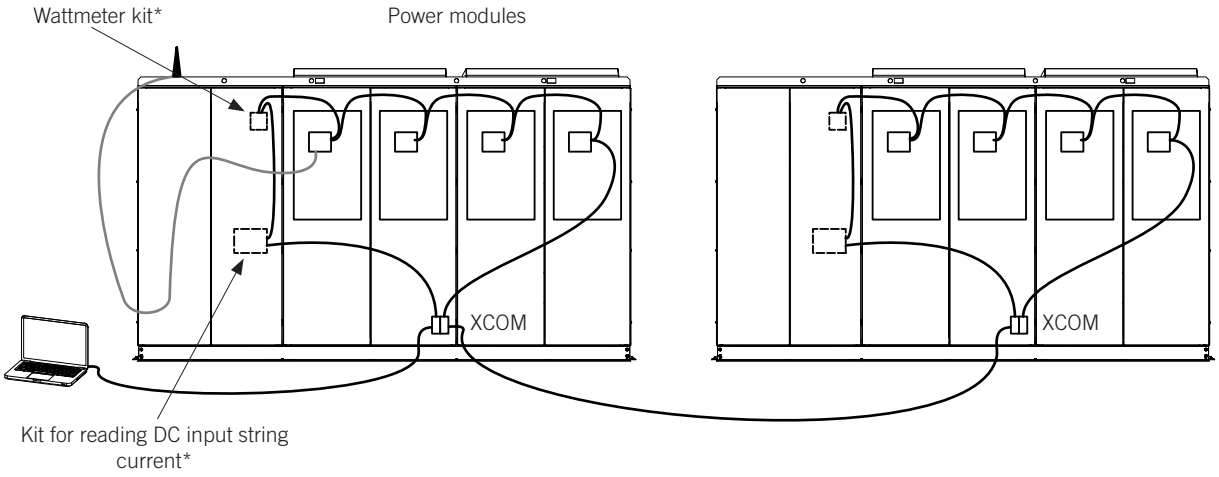
11.5. Communication via GSM/GPRS

At the request of the installer, inverters may optionally incorporate hardware for communicating via GSM/GPRS.

The following electrical diagram shows the connection of one or more units to a computer via GSM/GPRS.



GSM/GPRS communication for one inverter



GSM/GPRS communication for several inverters

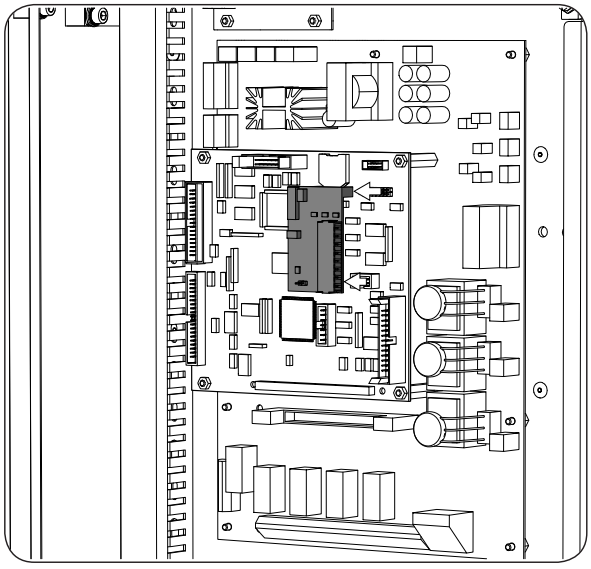
* optional.

Signal conversion to the communications ring installed in the inverter is made using the GSM/GPRS communications card, via the RS-485 RTU serial connection.

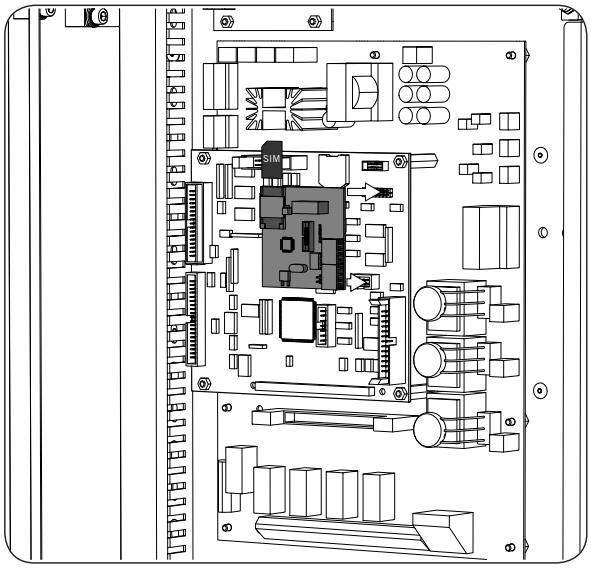
The module connections and possible optional kits installations are made as explained in Section *"11.3. Communication via RS-485"*.

If this communications card is ordered once the unit has been installed, carry out the following steps to install the electronics block of power module number 1:

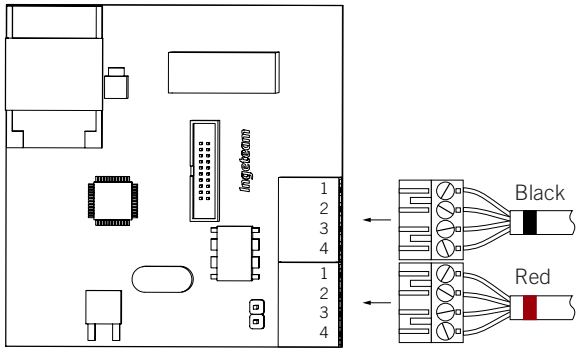
1. Disconnect the RS-485 communications card installed as standard in the unit and disconnect the communications cable from positions 1, 2, 5 and 6 of the aerial connector.



2. Fit the GSM/GPRS communications card to connectors J11 and J12 of the control card and insert the SIM card as shown in the figures below.



3. Wiring the aerial connector that comes with the GSM/GPRS communications card to the cable with the red mark and the cable with the black mark. The positions to be wired are as follows:



Pin	Cable colour
1	Brown
2	White
3	Green
4	Grid

4. Connect the antenna cable to the antenna output on the card and feed it out through the cable entries on the bottom of the housing. Connect the end that goes outside to the antenna and attach it via its magnet to the unit's housing.

If the GSM/GPRS communications card is ordered with the unit, the card is provided assembled on the control board and a bag (attached with a tie) containing the antenna cable. Connect the antenna cable to the antenna output on the card and feed it out through the cable entries on the bottom of the housing. Connect the end that goes outside to the antenna and attach it via its magnet to the unit's housing.

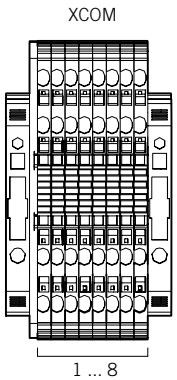
11.6. Ethernet RDCom communication

At the request of the installer, inverters may optionally incorporate Ethernet RDCom (Read Data Communication) hardware for communicating via Ethernet. Its installation divides the data bus in two and incorporates a new Ethernet TCP/RS-485 converter. The new data bus is used to read data both from the inverter and from possible optional kits.

This communications hardware complements the various communications options seen previously, with the use of Ethernet TCP communications recommended. These will be used as a bus to write data to the inverters.

Depending on installation requirements, it will be necessary to incorporate these additional communications to enable plant control. The inclusion of this communications option will need to be studied with Ingeteam when designing the PV installation.

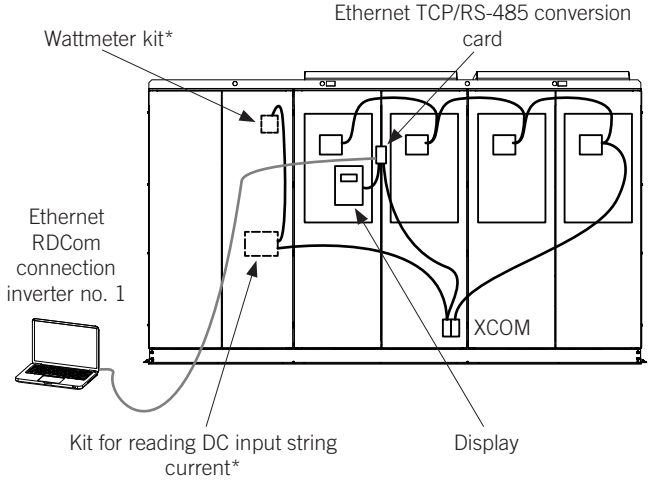
Installing this option results in the modification of the XCOM terminal strip. The new configuration of this terminal strip is shown below.



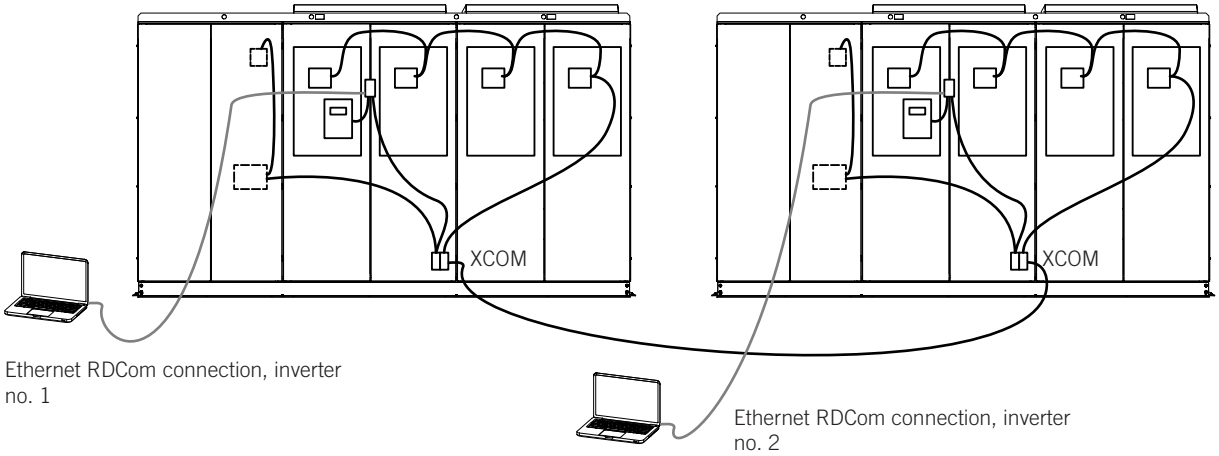
XCOM		
Reading (Ethernet RDCom connection)	1	RS-485 B (+)
	2	RS-485 A (–)
	3	GND
	4	Ground
Writing (power module connection)	5	RS-485 B (+)
	6	RS-485 A (–)
	7	GND
	8	Ground

The connection with Ethernet RDCom communications for data reading is made at the TCP/RS-485 converter located between power modules 1 and 2.

The following diagram shows the electrical diagram for one or more units.



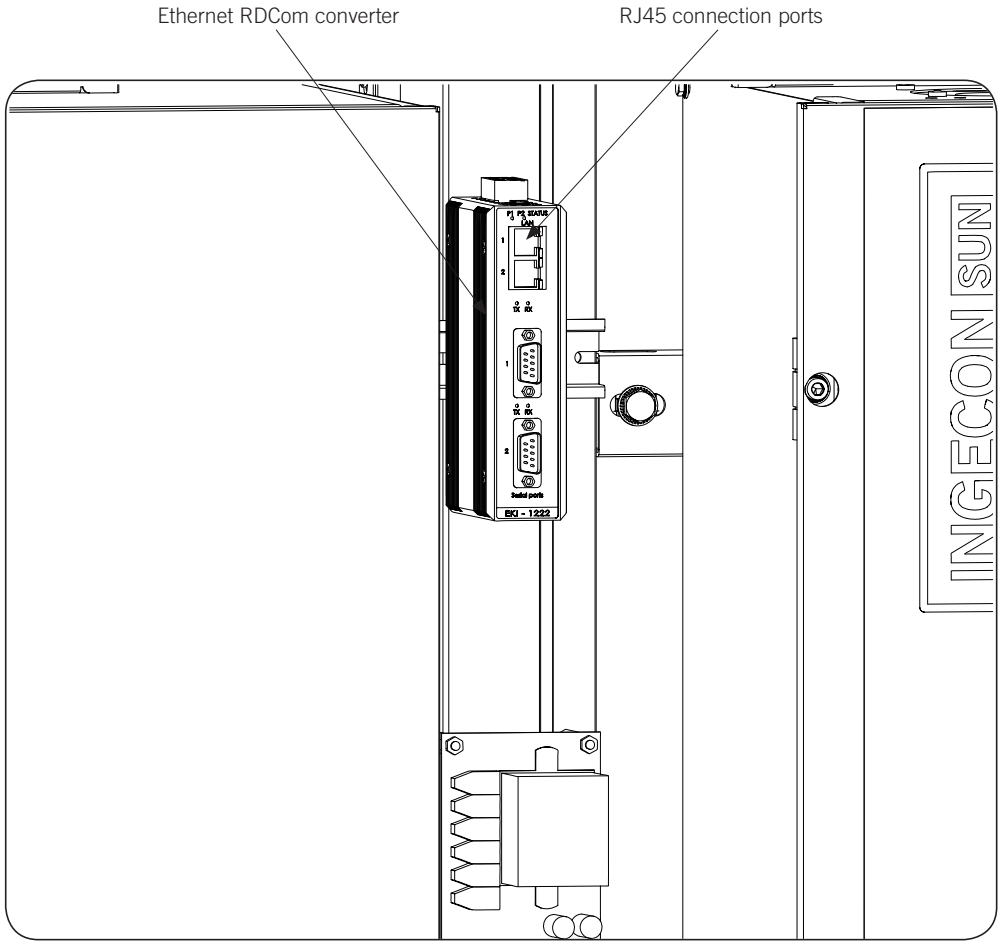
Ethernet RDC communication for one inverter



Ethernet RDC communication for several inverters

* optional.

The following figure details the location of the Ethernet RDCom converter between power modules 1 and 2.


Ethernet RDCom converter
RJ45 connection ports
INGECON SUN

12. Connection options

These units offer the possibility as standard of connecting various options for unit control and/or monitoring. The installer can decide to use them or not depending on the requirements of each installation.

To find the different components listed below, consult Section *"2.7. Location of components"*.

12.1. Safety instructions for connecting optional equipment

Refer to Section *"3. Safety"* and the safety paragraph in this section before operating the equipment.

Make sure there is no voltage present on the unit before carrying out any connections. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

Ingeteam accepts no liability for any damages caused by incorrect connection.

After connecting the options, **do not switch the power on** until you have made all other connections and the unit has been closed.

Use the Personal Protective Equipment specified in the section *"3.2. Personal Protective Equipment"*.

12.2. Wiring requirements for connecting optional equipment

- The wiring for connecting the options needs to be carried out by the client.
- Use only copper and aluminium cables.
- The minimum section is 0.75 mm^2 and the maximum 2.5 mm^2.
- This cable must be no longer than 20 m.
- The normally closed contact must be capable of working at 230 VAC 50/60 Hz and a power of 40 VA.

12.3. Connection process for monitoring components external to the unit

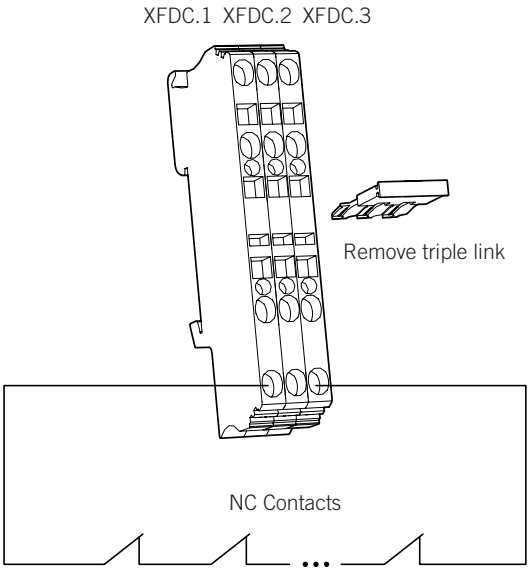
The inverter enables the monitoring of an element outside the unit (temperature sensor, sensor detecting the opening or closing of external junction boxes, main external AC breaker, etc.).

In the case of a fault in a monitored element, the inverter goes into shutdown status and will not operate until the element returns to its normal condition.

To connect the external monitoring components to the unit, the XFDC terminal block is provided in the DCAC supply module.

Normally closed volt-free contacts should be fitted for monitoring between terminals XFDC.1 and XFDC.2 by removing the triple horizontal link short-circuiting them, as shown in the following figure, and installing a double link between XFDC.1 and XFDC.2.

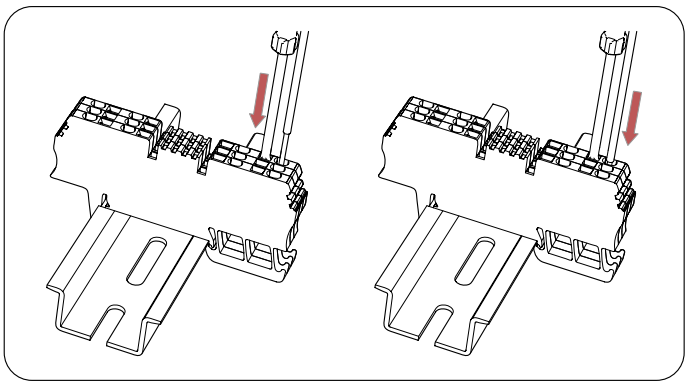
If the equipment has the earth start-up kit, these contacts must be installed in a double link to between XFDC.2 and XFDC.3, which must be removed.



- Open contact: fault in the monitored component.
- Closed contact: no fault at monitored component.

To make the connection, follow the following steps:

1. Strip the cables.
2. Crimp the wire ends according to the wire gauge being used.
3. Open the terminal. The terminals used in this terminal strip are of the clamp type. To insert the cable into the desired position press with a flat head screwdriver, insert the cable and then remove the screwdriver.



4. Remove the triple horizontal link.
5. Insert a new two-position horizontal link between terminals XFDC.2 and XFDC.3.

If the PV array grounding kit is installed in this unit, this monitoring will be in series with the grounding, using terminals XFDC.2 and XFDC.3. It will not be necessary to use any links in this case.

12.4. DC isolating switch remote control connection process

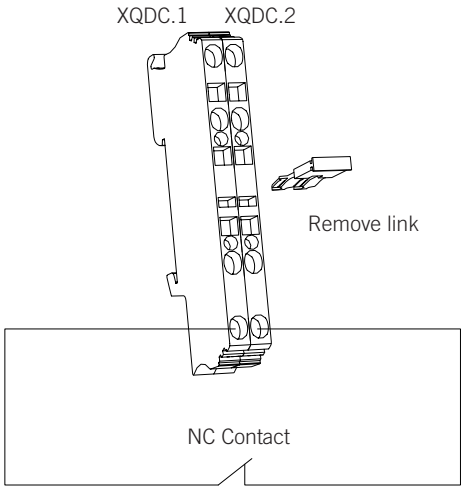
It is not possible to use the same contact to open the DC isolating switch of several units.

The inverter enables an emergency shutdown to be performed externally. This remote actions is equivalent to pressing the emergency stop button. The inverter enters a shutdown conditions, safely disconnecting itself from the grid and opening the motorised isolating switch.

This operation enables complete disconnection of the PV array, ensuring the removal of all DC voltage from the inverter input.

To connect the remote control for the DC isolating switch, terminal block XQDC is provided in the DCAC supply module.

A **normally closed volt-free** contact should be fitted between terminals XQDC.1 and XQDC.2 by removing the horizontal link short-circuiting them, as shown in the following figure.

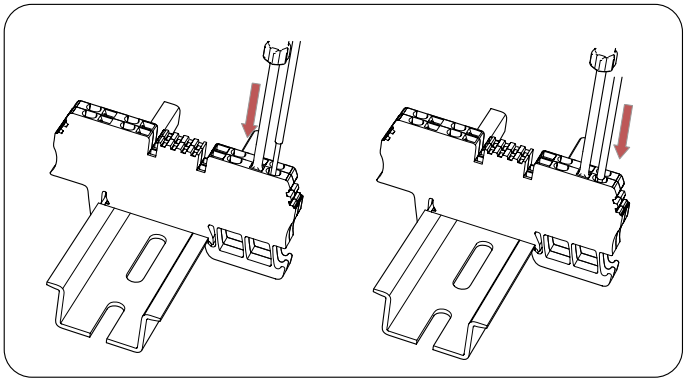


- Open contact: inverter switches to the shutdown condition and DC isolating switch to Off.
- Closed contact: inverter switches to the run condition and DC isolating switch to On.

To make the connection, follow the following steps:

1. Strip the cables.
2. Crimp the wire ends according to the wire gauge being used.

3. Open the terminal. The terminals used in this terminal strip are of the clamp type. To insert the cable into the desired position press with a flat head screwdriver, insert the cable and then remove the screwdriver.



4. Remove the horizontal link.

The motorised DC isolating switch has a limited number of operating cycles, so excessive use may lead to premature wear.

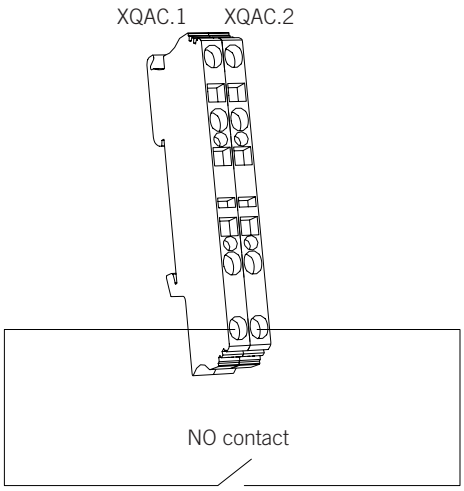
12.5. AC switch remote control trip connection process

It is not possible to put the QAC circuit breakers in parallel.

In units incorporating an AC circuit breaker, remote control tripping can be carried out. Opening this circuit breaker causes the complete disconnection of the AC power connection. After the disconnection of the AC part, the inverter will disconnect automatically. Once the AC circuit breaker has been tripped, it needs to be reset manually.

In units fitted with an AC switch, to connect the remote control trip for the this switch, terminal block XQAC is provided in the DCAC supply module.

Install a **Normally open volt-free** contact between the terminal block XQAC.1 and XQAC.2.



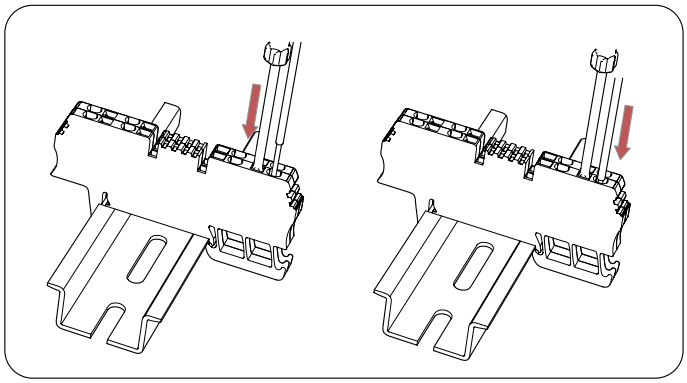
- Open contact: AC switch On.
- Closed contact: AC switch Off (tripped).

After tripping the switch it must be reset manually.

To make the connection, follow the following steps:

1. Strip the cables.

2. Crimp the wire ends according to the wire gauge being used.
3. Open the terminal. The terminals used in this terminal strip are of the clamp type. To insert the cable into the desired position press with a flat head screwdriver, insert the cable and then remove the screwdriver.



The AC circuit breaker has a limited number of operating cycles, so excessive use may lead to premature wear.

Opening the AC circuit breaker causes disconnection of the equipment due to the lack of grid connection. This disconnection is safe, but Ingeteam does not recommend the use of this procedure as a regular disconnection method. Excessive use may lead to anomalies in inverter use.

12.6. Insulation fault /grid connection connection process

The configuration of the equipment to make the contact perform one or another function is factory set and must be specifically requested from Ingeteam at the time of ordering.

To connect the insulation fault/grid connection, terminals U1nX2.5 and U1nX2.6 are provided in each electronics block.

This normally open contact withstands a voltage of 230 VAC and a maximum current of 10 A.

Each electronics block is assigned its own contact, which detects the isolation operation or failure of the electronics block in question. Only the electronics block contact operating as “master” will work. For this reason, all contacts must be connected in parallel.

It can be used for one of two functions:

Detecting an insulation fault in the DC circuit

- Open contact: there is no insulation fault in the DC circuit.
- Closed contact: there is an insulation fault in the DC circuit.

Indicator showing that the unit is connected to the mains via its internal contactor

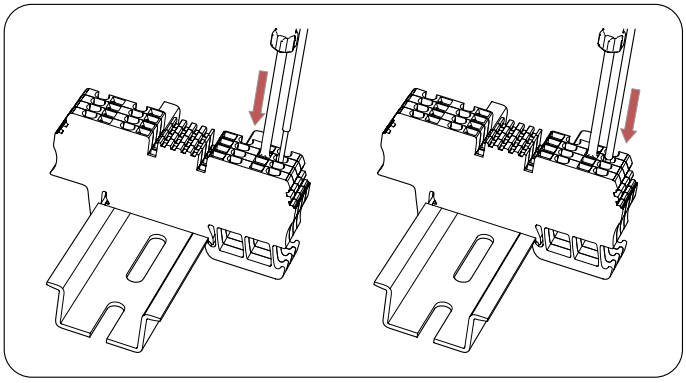
- Open contact: internal contactor for connecting to the grid is open; the inverter is not connected to the grid.
- Closed contact: internal contactor for connecting to the grid is closed; the inverter is connected to the grid.

Regardless of the setting of this contact the unit continues to measure the insulation of the DC part.

To make the connection, follow the following steps:

1. Strip the cables.
2. Crimp the wire ends according to the wire gauge being used.

3. Open the terminal. The terminals used in this terminal strip are of the clamp type. To insert the cable into the desired position press with a flat head screwdriver, insert the cable and then remove the screwdriver.



13. DC connection

This chapter explains the requirements and process for wiring the DC cabling to the unit.

Read carefully before starting the connection process.

To find the different components listed below, consult Section *"2.7. Location of components"*.

In the sketches showing the various DC connection processes, the mounting plate is shown open at both ends at 45° in order to give a clearer idea of the various configurations. The mounting plate forms a right angle at its ends inside the unit.

13.1. Safety instructions for the DC connection

Refer to Section *"3. Safety"* and the safety paragraph in this section before operating the equipment.

DC cables connected to photovoltaic modules exposed to sunlight may be at a dangerously high voltage which could cause serious injury and even death.

Before connecting DC cables to the inverter verify the absence of voltage.

Make sure there is no voltage present on the unit before carrying out any connections. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

The polarities indicated in the following figure must be followed. Ingeteam accepts no liability for any damages caused by incorrect connection.

Before connecting the wires, ensure that the DC fuses are not fitted in the bases. Install fuses once you have connected the wiring and checked that the polarity is correct.

Ingeteam accepts no liability for the consequences of non-compliance with these instructions.

There is a risk of fire when using wiring gauges with a lower permissible current than the maximum possible from the photovoltaic modules.

Failing to apply the correct tightening torques to the connection terminals causes a risk of overheating and fire.

In order to keep the nuts and bolts of the unit in good condition it is important to make sure there is no dirt or shavings in the threads when screwing them in and apply a suitable lubricant.

After connecting the DC wiring, **do not switch the power on** until you have made all other connections and the unit has been closed.

Use the Personal Protective Equipment specified in the section *"3.2. Personal Protective Equipment"*.

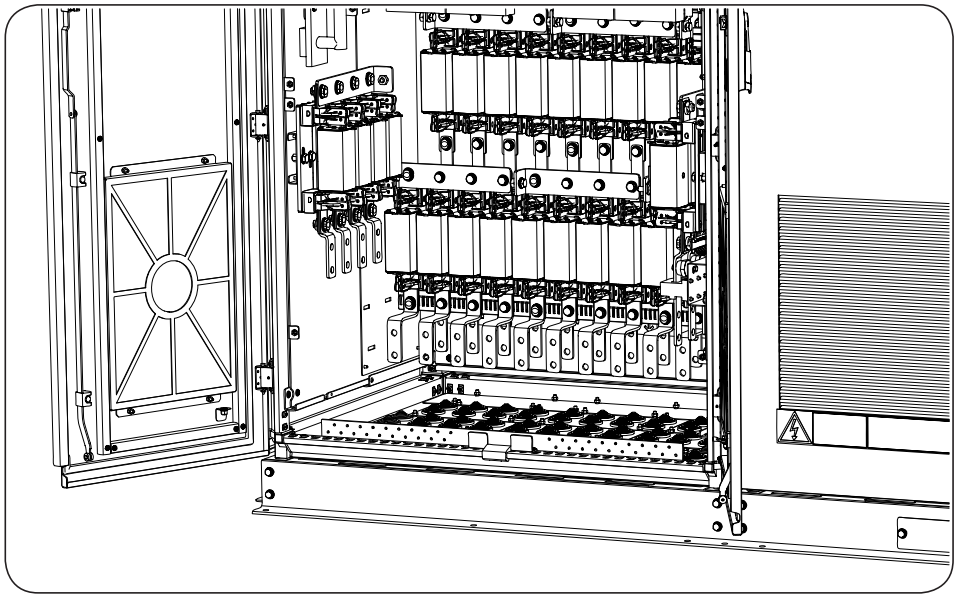
After working on the terminals the polycarbonate guard must be put back into place.

13.2. Wiring requirements for connecting DC connection

- Use only copper and aluminium cables.
- The DC connection cables must withstand at least 1000 V between poles and between each pole and ground.

13.3. Connection area

The PV array connections are made in the part of the DCAC supply module shown in the following figure.



The DC supply configuration will be different depending on the number of modules.

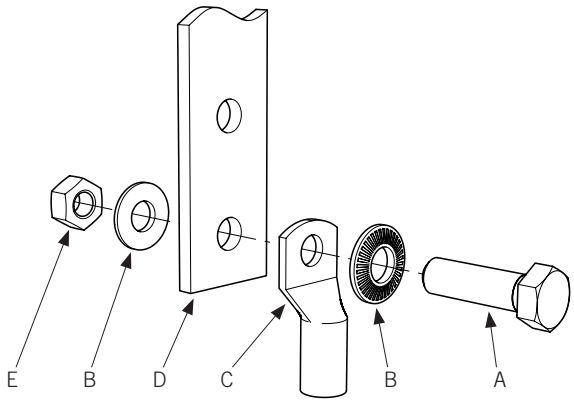
13.4. DC connection via a terminal

13.4.1. Requirements for DC connection via a terminal

- For DC connection, compression terminals must be used. The terminals used may have either one or two 13 mm diameter holes. Where there are 2 holes, these will be 44.5 mm apart.
- The inverter connection plates are made of copper. You are recommended to use only tinned copper terminals. If you use aluminium cables, you must use bimetallic terminals or other components that eliminate the galvanic couple of the joint.
- No more than two cables should be connected to each DC connection plate hole. Each connection plate has 8 holes, so the maximum number per pole will be 16.
- Only use the screws and washers provided by Ingeteam upon delivery of the unit.
- All torques indicated must be respected and maintained.

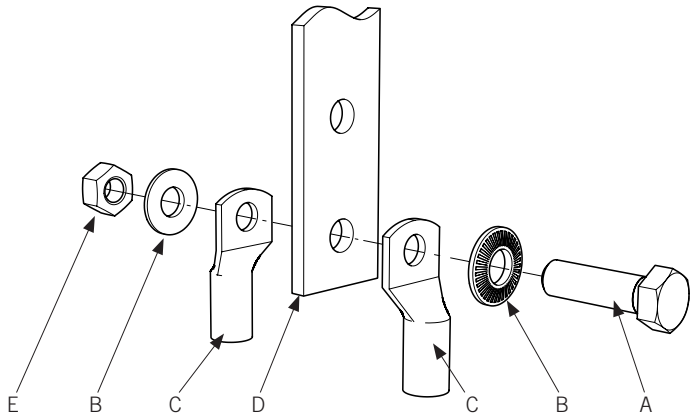
	Wire gauge	Tightening torque. M12 st. st. screws (unlubricated)
Minimum	In accordance with the current circulating through the conductors	65 Nm
Maximum	300 mm^2	

DC connection via a terminal with one hole



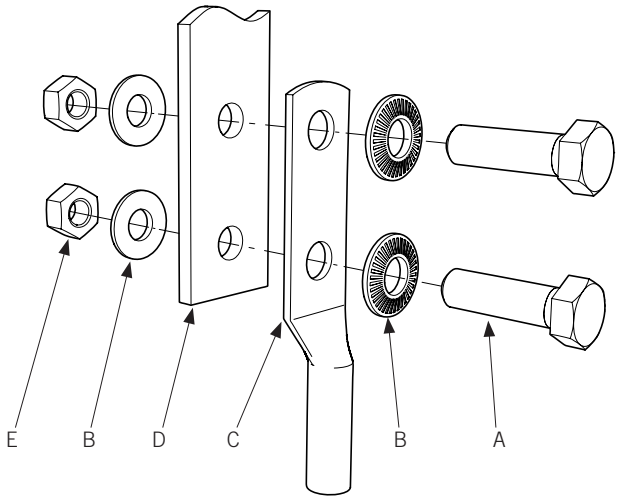
A. M12 hex head screw.
B. M12 washer.
C. Terminal.
D. Connection plate.
E. M12 nut.

DC connection via two terminals with one hole



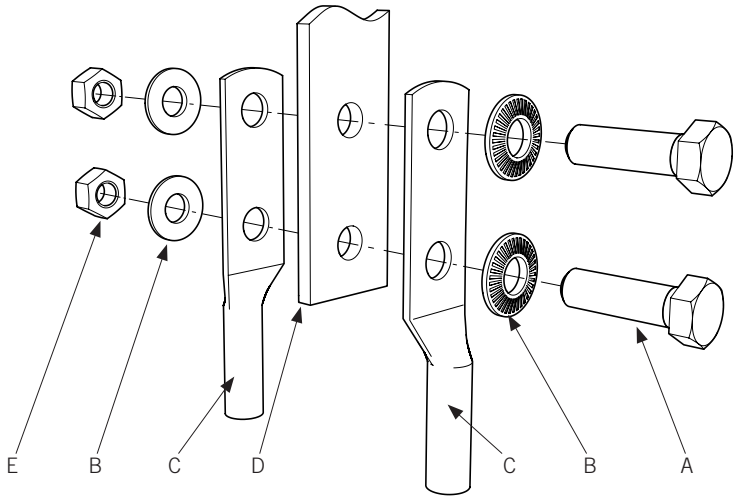
A. M12 hex head screw.
B. M12 washer.
C. Terminal.
D. Connection plate.
E. M12 nut.

DC connection via a terminal with two holes



A. M12 hex head screw.
B. M12 washer.
C. Terminal.
D. Connection plate.
E. M12 nut.

DC connection via two terminals with two holes



A. M12 hex head screw.
B. M12 washer.
C. Terminal.
D. Connection plate.
E. M12 nut.

13.4.2. DC connection process

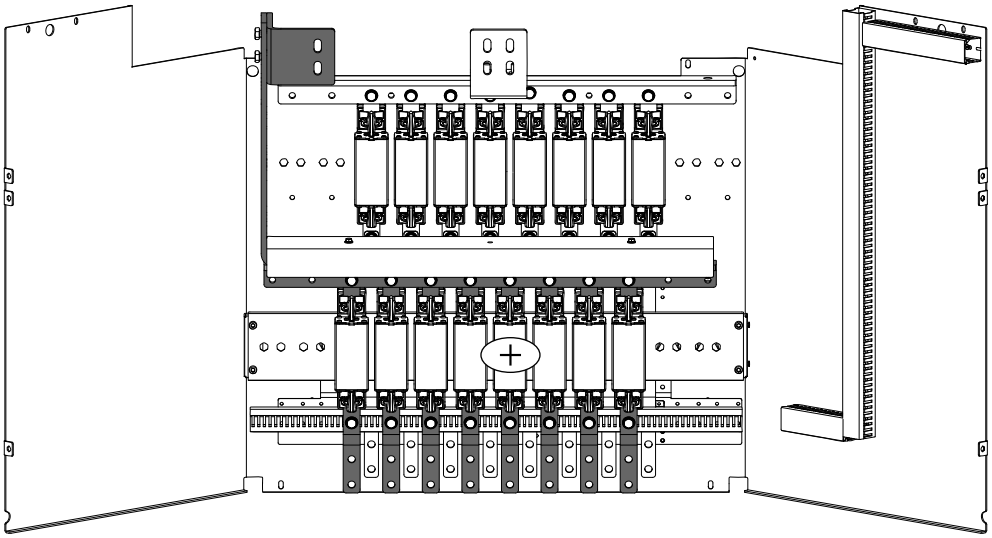
Reverse connection of the PV array would have fatal consequences on the unit and could cause serious damage to persons close to the unit.

1. Remove the protective polycarbonate sheet.
2. If the unit has DC feed fuses, ensure that these are not fitted in their bases. If this is not the case, remove them (see Section *"13.5. Connection/disconnection of the DC fuses"*).
3. Strip the cable according to the size of terminal to be used.
4. Crimping the terminal on the cable.
5. Clean the contact surfaces on both the terminal and the connection bar with a clean cloth and ethanol.
6. Connect the terminal to the connection bar using the (previously lubricated) screws and washers supplied by Ingeteam with the unit, respecting the torque specified.
7. Check polarity of the strings connected to the inverter. If the polarity is incorrect, change it. Connecting a string with the incorrect polarity and starting up the unit can cause irreversible damage to the unit.
8. If the unit has fuses, install them in their bases (see Section *"13.5. Connection/disconnection of the DC fuses"*).
9. Reinstall the protective polycarbonate sheet.

Units with 16 fuses

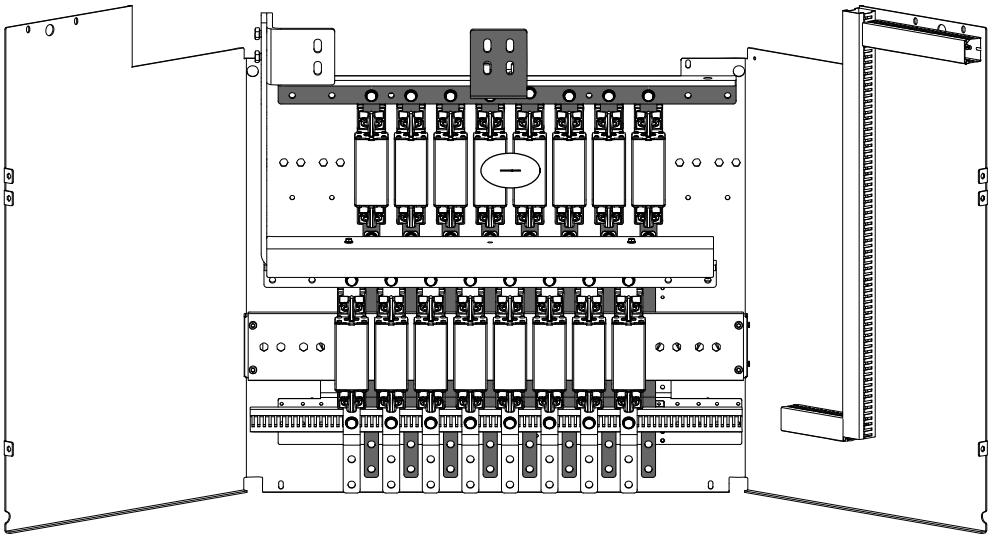
Respect the connections indicated in the figure bearing in mind the polarity.

See the figure below before connecting the positive pole:



Positive pole connection

See the figure below before connecting the negative pole:



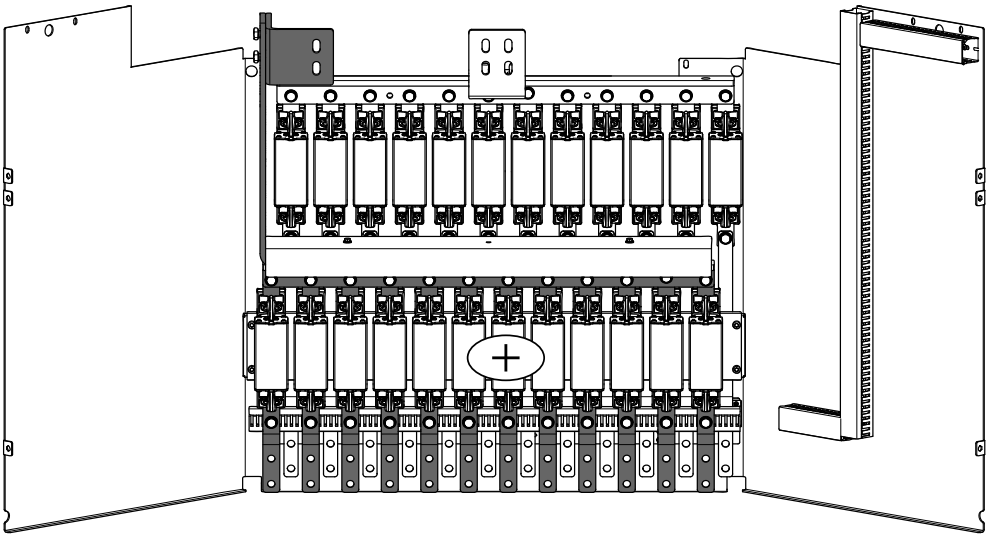
Negative pole connection

Ensure the correct connection of the cable and terminal.

Units with 24 fuses

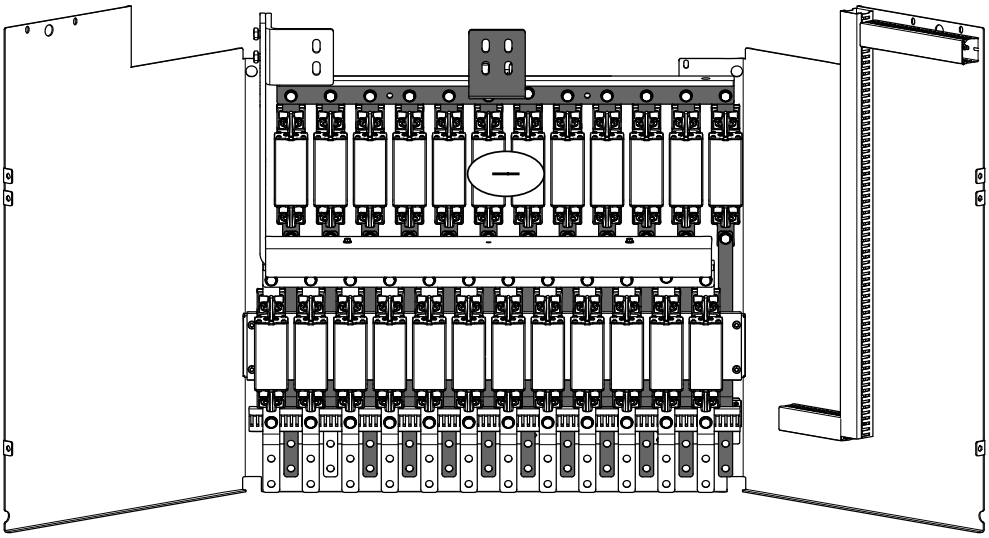
Respect the connections indicated in the figure bearing in mind the polarity.

See the figure below before connecting the positive pole:



Positive pole connection

See the figure below before connecting the negative pole:



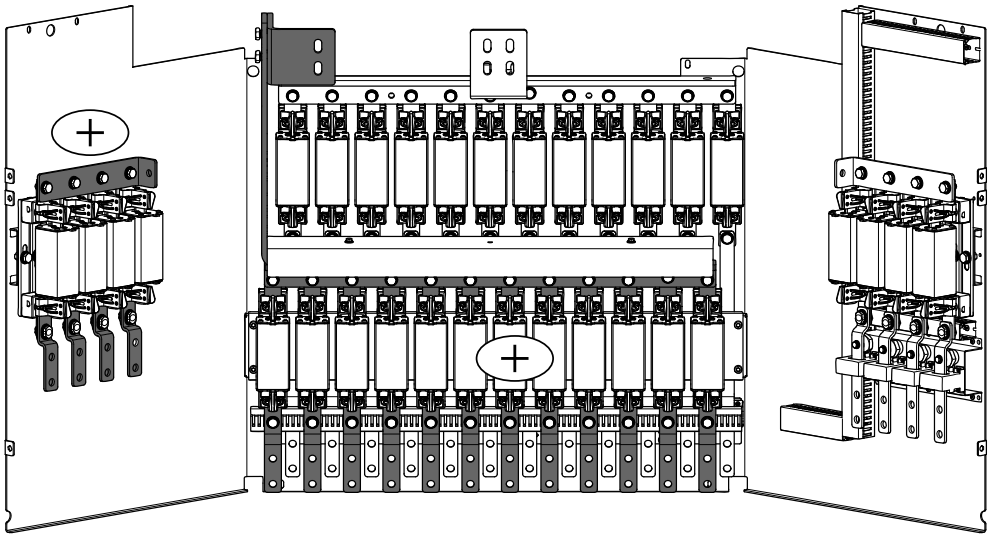
Negative pole connection

Ensure the correct connection of the cable and terminal.

Units with 32 fuses

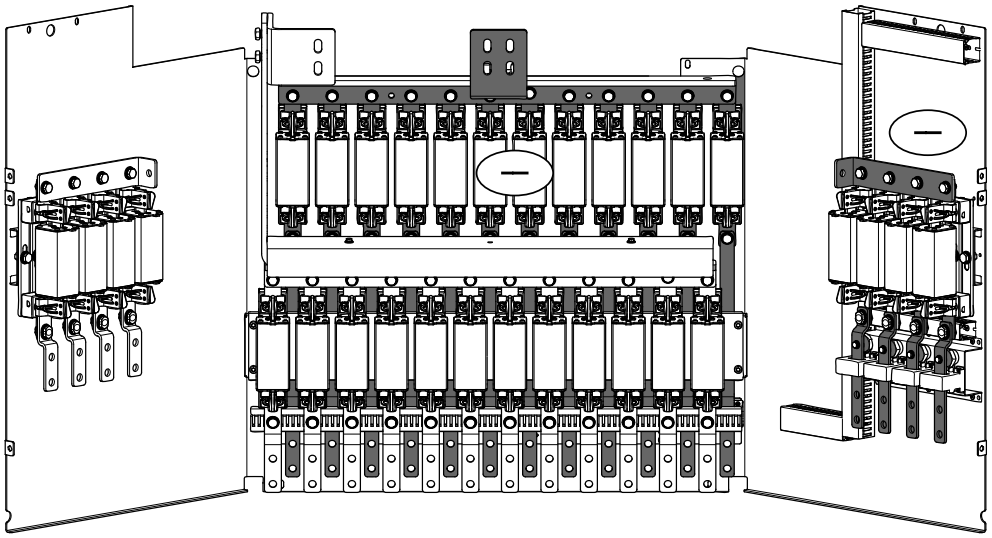
Respect the connections indicated in the figure bearing in mind the polarity.

See the figure below before connecting the positive pole:



Positive pole connection

See the figure below before connecting the negative pole:



Negative pole connection

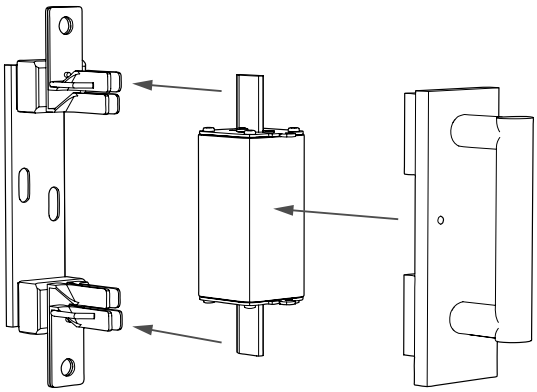
Ensure the correct connection of the cable and terminal.

13.5. Connection/disconnection of the DC fuses

After connecting the cables, the DC fuses should be fitted.

To install fuses in their holders the unit comes with a tool to facilitate this, as also for removing them. This tool is located in the DCAC supply module as shown in the following diagram.

1. To install the fuse insert the guides on the fuse into the guides on the tool and insert the fuse into its holder, making sure that the fuse is completely inserted.



2. When it has been installed, remove the tool.

The process for removing the fuses is the reverse of the above.

14. AC connection

This chapter explains the requirements and process for wiring the AC cabling to the unit.

Read carefully before starting the connection process.

To find the different components listed below, consult Section *"2.7. Location of components"*.

14.1. Safety instructions for the AC connection

Refer to Section *"3. Safety"* and the safety paragraph in this section before operating the equipment.

Before connecting AC cables to the inverter verify the absence of voltage.

Make sure there is no voltage present on the unit before carrying out any connections. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

Ingeteam accepts no liability for any damages caused by incorrect connection.

There is a risk of fire when using wiring gauges with a lower permissible current than the maximum possible current.

Failing to apply the correct tightening torques to the connection terminals causes a risk of overheating and fire.

In order to keep the nuts and bolts of the unit in good condition it is important to make sure there is no dirt or shavings in the threads when screwing them in and apply a suitable lubricant.

After connecting the AC wiring, **do not switch the power on** until you have made all other connections and the unit has been closed.

Use the Personal Protective Equipment specified in the section *"3.2. Personal Protective Equipment"*.

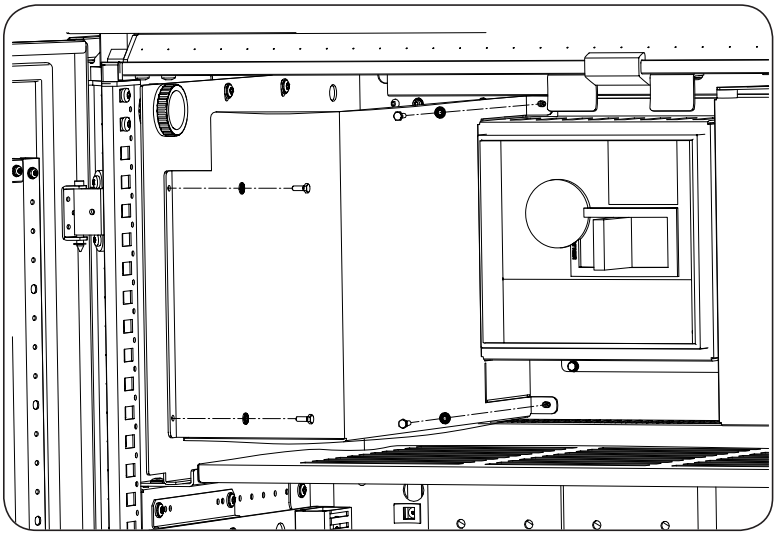
After working on the terminals the polycarbonate guard must be put back into place.

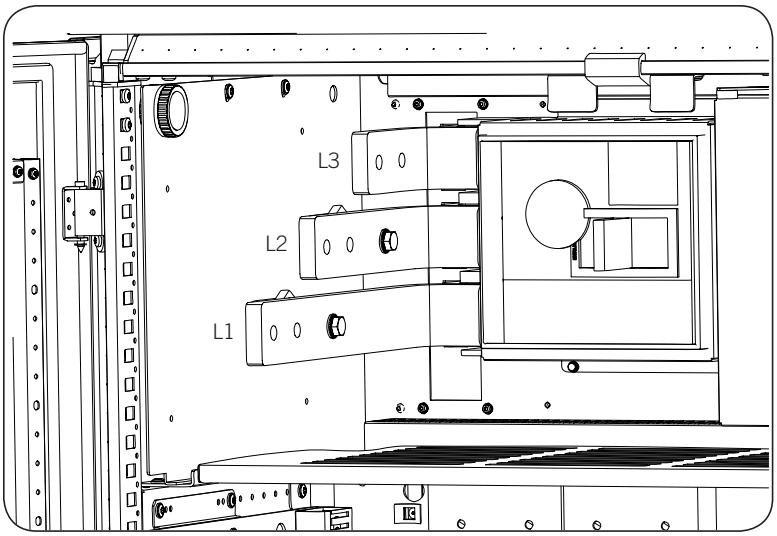
14.2. Wiring requirements for connecting AC connection

- The correct dimensioning of the AC wiring is the installer's responsibility, depending on the plant specifications and inverter characteristics.
- The wire gauge must be based on each unit's continuous currents. Incorrect dimensioning can lead to overheating and fires.
- Use only copper and aluminium cables.
- The cables for connection to the unit grid must withstand at least the phase voltage and 1000 V between a phase and ground.
- If the inverter and the grid connection point are far enough apart to require the use of longer cables, an external distribution box must be used close to the investor to make this connection.

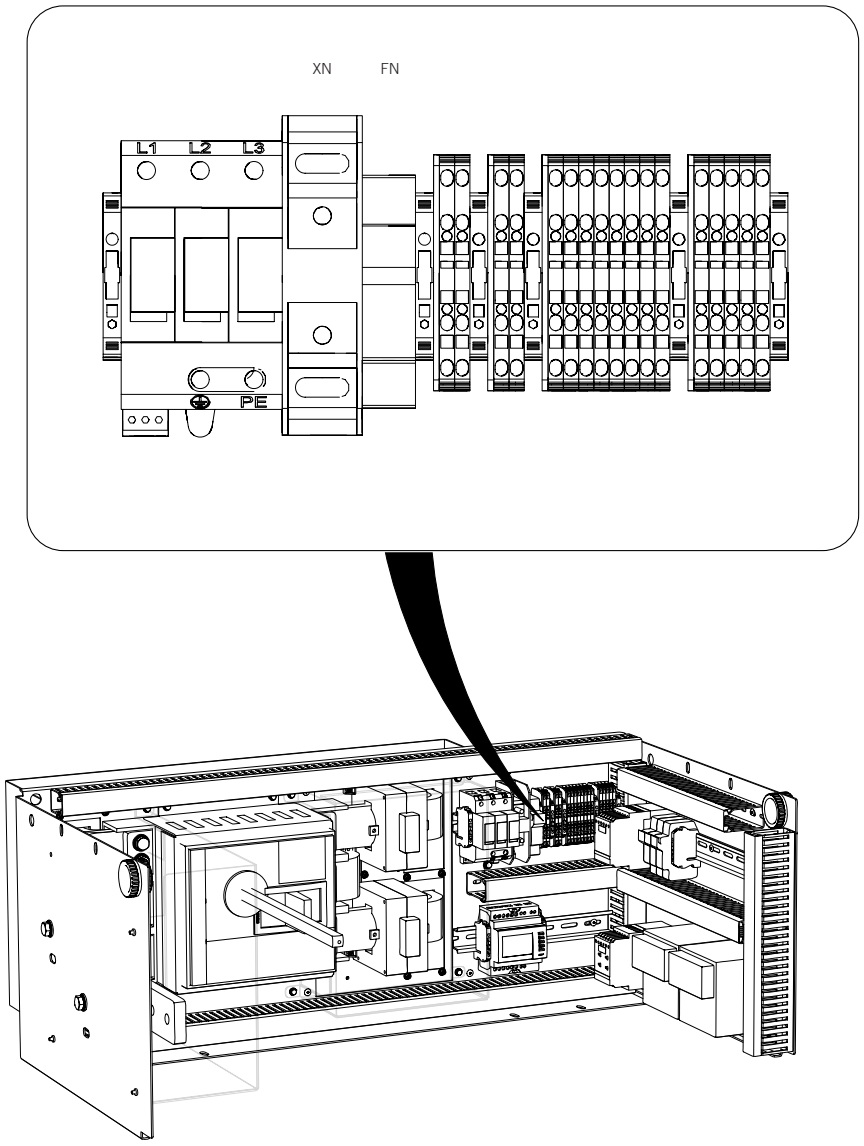
14.3. Connection area

The AC supply is located in the DCAC supply module. Remove the protective cover to gain access to the plates.

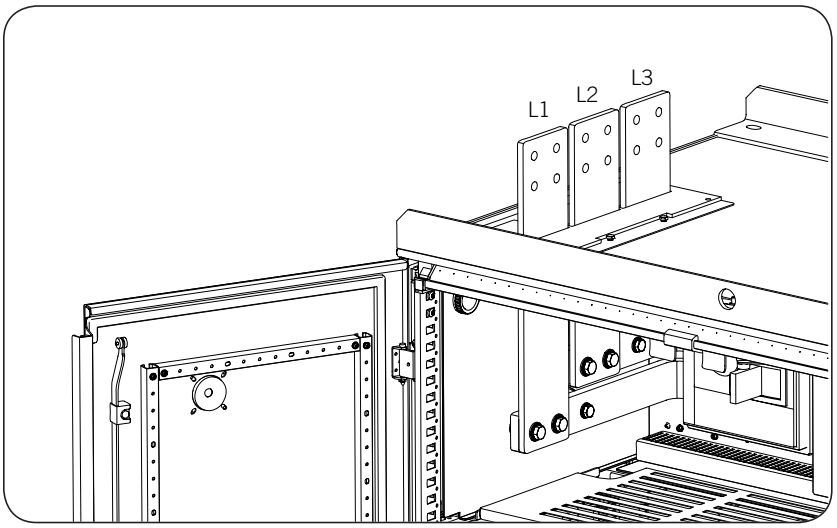




The neutral connection is made to the XN terminal and is protected by means of the 4 Amp FN fuse located in the DCAC supply module.



Optionally, it can be requested that the connection plates for the AC supply are located on the top of the unit, as shown in the following figure.



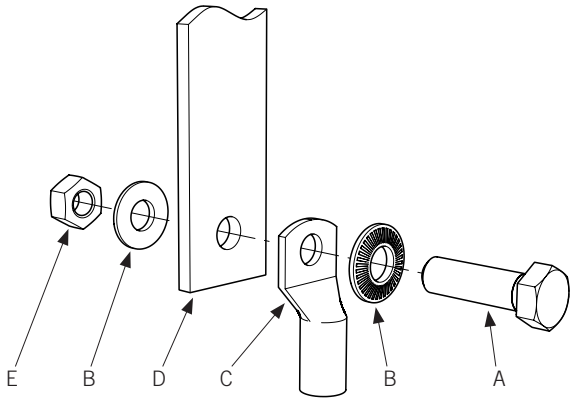
14.4. AC connection via a terminal

14.4.1. Requirements for AC connection via a terminal

- For AC connection, compression terminals must be used. The terminal used must have a 13 mm diameter hole.
- Use only tinned copper terminals.
- For AC connection, no more than two cables should be connected to each connection plate hole. Each phase has two holes per plate, hence the maximum number of cables per phase is four.
- Only use the screws and washers provided by Ingeteam upon delivery of the unit.
- All torques indicated must be respected and maintained.

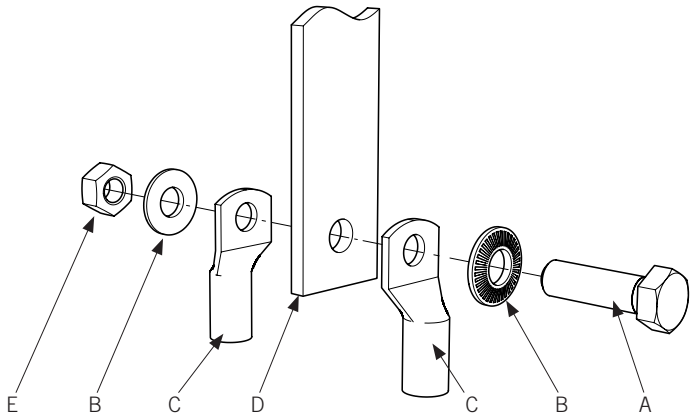
	Wire gauge	Tightening torque
Phases		
Maximum of four cables per phase		
Minimum	Units with 2 power modules: 2 x 95 mm^2 per phase Units with 3 power modules: 3 x 95 mm^2 per phase Units with 2 power modules: 4 x 95 mm^2 per phase	65 Nm, M12 st. st. screws (unlubricated)
Maximum	300 mm^2	
Neutral		
Maximum	35 mm^2	8 Nm, M6 terminal

AC connection via a terminal with one hole



A. M12 hex head screw.
B. M12 washer.
C. Terminal.
D. Connection plate.
E. M12 nut.

AC connection via two terminals with one hole



A. M12 hex head screw.
B. M12 washer.
C. Terminal.
D. Connection plate.
E. M12 nut.

14.4.2. AC connection process via a terminal

1. Remove the protective polycarbonate sheet.
2. Strip the cable according to the size of terminal to be used.
3. Crimping the terminal on the cable.
4. Clean the contact surfaces on both the terminal and the connection bar with a clean cloth and ethanol.
5. Connect the terminal to the connection bar using the (previously lubricated) screws and washers supplied by Ingeteam with the unit, respecting the torque specified.
6. Reinstall the protective polycarbonate sheet.
7. Ensure the correct connection of the cable and terminal.

14.4.3. Connecting the AC neutral

1. Strip the cable according to the size of terminal to be used.
2. Crimp the wire ends according to the wire gauge being used.
3. Connect the terminal to the XN terminal, respecting the torque specified.
4. Ensure the correct connection of the cable.

After connecting the neutral, ensure correct configuration of the U1nXAC.0 and U1nXAC.1 terminal strip for each power module as explained in Section *"7.7. Requirements for transformers"*.

15. Commissioning

This chapter details the process for the commissioning of the unit.

See Section *"3. Safety"* before operating the equipment.

To find the different components listed below, consult Section *"2.7. Location of components"*.

15.1. Equipment inspection

These models are equipped with a series of thermomagnetic switches to protect their various components. These should be closed prior to unit start-up.

Before working on the thermomagnetic circuit breakers, check that there are no electrical hazards inside the unit.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

15.1.1. Inspection

Before inverter start-up, a general inspection of the units must be carried out involving mainly:

Wiring

- Check that there are no loose wires. The insulation clearance is 20 mm between cables.
- Check that the cables are correctly connected.
- Check that these cables are in a good condition and that there are no hazards in their environment which damage them, such as sources of intense heat, objects which could cut them or arrangements which put them at risk of impacts or pulls.

Removing the polycarbonate type protections for performing this inspection is strictly forbidden.

DCAC supply module

- Check that the DC arresters are properly inserted into the base and that their "status window" is not red.
- Turn thermomagnetic circuit breaker QM to On.
- Check that the DC isolating switch is in automatic mode (*AUTO*).

  Exceptionally, and only for maintenance or servicing tasks, the DC isolating switch can be operated manually. To perform this operation, push the latch on the yellow plunger so that the latter slides towards the left, providing access to the housing for the rotary knob.

  The rotary knob is on the left door of the DCAC supply module.

  Check that the AC arresters are properly inserted into their bases and that their "status window" is not red.
- Set thermomagnetic circuit breaker Q4 to On.

Power modules

- Turn thermomagnetic circuit breaker QAUX to On.
- Set thermomagnetic circuit breaker Q2 to On.
- Check the status of fuses FACn1, FACn2 and FACn3.

15.1.2. Shutting down

Ensure during installation operations that the unit's level of sealing has not been altered during connection of the unit.

In all connections, give cabling enough length inside the unit so they don't pull on the internal electrical connections.

Check that the cables used have the same degree of protection as the unit itself.

Doors

If the unit doors have opened at some point, close them and check they are properly closed.

The guarantee does not cover damage caused by inadequate sealing of the unit.

Safety measures

Opening any of the doors on the unit causes the unit to be disconnected from the grid and opens the corresponding motorised DC isolating switch.

15.2. Equipment configuration

Once the unit has been mounted in its final position and has been solidly secured, ensure that the inverter is properly set up.

The units always come with factory settings, but when one of the electronics blocks of the units are replaced or repositioned, the electronics block in question must be set up.

Make sure there is no voltage present on the unit before carrying out any connections. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

15.2.1. Configuring the Modbus Node of an electronics block

Each power module has a factory-assigned ModBus Node number. By default, the nodes assigned will correlate with the power module number (1, 2, 3 and 4).

It may be necessary to adapt the ModBus Node numbers to the desired plant communications configuration.

To be able to carry out this configuration, the unit's auxiliary power supply needs to be connected to supply each module's electronics block. The CAN Nodes must be correctly configured. If an electronics block has been replaced, it will need to be configured before use as explained in Section *"19.5.1. CAN number setting of an electronics block"*.

Follow this procedure:

1. Check that the communication elements are in proper working order.
2. In the "SETTINGS" menu. Select "Change inverter number" and introduce the right one.
3. Check that the communication also works with the new node number.

15.3. Start-up

First carry out a general visual inspection and wiring check, then proceed to connect the unit to the grid by following the guidelines in this document.

The tasks outlined for this step must be carried out with all the doors of the unit closed, thus avoiding possible contact with live components.

15.3.1. Start-up

Once the wiring has been completed and all components of the inverter have been checked, start up the unit. Follow the following steps in the order they appear:

1. Perform the checks indicated in Section *"15.1.1. Inspection"*.
2. Verify that the FN intake neutral fuse is correctly installed. Said fuse is located in the upper part of the supply module.
3. Make the connection and switch the power on to the inverter's main AC supply. In units with no thermomagnetic breaker for AC protection built into the inverter, it is necessary to place an external shut-off element with protection and switching power.
4. Close the AC thermomagnetic breaker if the unit has one.
5. The motorised DC isolating switch must then be closed automatically, supplying power to the DC part of each power module.
6. Close all unit's doors and check that the unit is in manual shutdown. If not, switch it to this condition as per Section *"16.4. Start/Stop"*.
7. Check that the variables on the monitoring menu are consistent; in particular the VAC and VDC levels (see Section *"16.5.1. Monitoring"*).
8. Check the alarms on each node display. If everything is in order, only alarm 1000H (manual shutdown alarm) should be displayed.
9. After checking the points above, start the inverter via display (see Section*"16.4. Start/Stop"*).

Failure to comply with the verification tasks described above releases Ingeteam from any liability for possible damage to the system or the inverter itself caused by such failure.

15.3.2. Checking and measurement

Once connected to the unit network, the green LED is still lit, verify that no error LED display is on. If any power module does not connect to the grid even though there is no alarm, this will be because the power from the PV array is not sufficient at this time. This procedure is normal for these units.

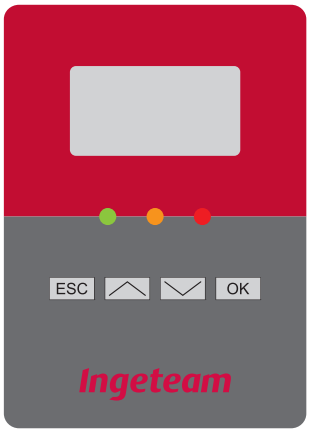
Check that the monitoring menu parameters are consistent:

- The voltage of the PV array should be between 350 and 1000 VDC.
- VAC voltage shown on the display must fall within operating ranges.
- The RMS value of currents Iac1, Iac2 and Iac3 displayed should be similar.
- There are no alarms in the inverter (0000H).

Ingeteam recommends checking the waveform of the current generated in the three phases using an ammeter clamp. Use the PPE listed in the *"3.2. Personal Protective Equipment"* section to get this reading.

During initial connection to the grid, Ingeteam recommends monitoring the temperatures inside the unit to check correct operation of the cooling system.

16. Display control



These inverters incorporate a Display + Keypad unit to interface with the installer and the user.

This interface allows the display of the main internal parameters and the configuration of the entire system during installation.

Parameters, variables and commands are organised as menus and submenus.

16.1. Keypad and LEDs

The keypad has four keys:

ESC	**Esc.** To exit a parameter, leave a menu and return to the next level up in the structure, to not confirm a change or not accept a suggestion.
^	**Up.** With this key you can scroll up the list of parameters or folders within the same level or increase the value of an editable parameter by one base unit.
v	**Down.** With this key you can scroll down the list of parameters or folders within the same level or decrease the value of an editable parameter by one base unit.
OK	**OK.** Serves to accept a parameter as valid, to enter a lower level menu in the structure, to confirm a change or accept a suggestion.

The front panel has three LEDs:

Green LED

- Slow flashing: Standby due to low irradiance. Not all power modules are connected.
- Fast flashing: Start-up process.
- On: Inverter connected to the grid.

Orange LED

Fast flashing: Alarm set off which does not shut down the inverter.

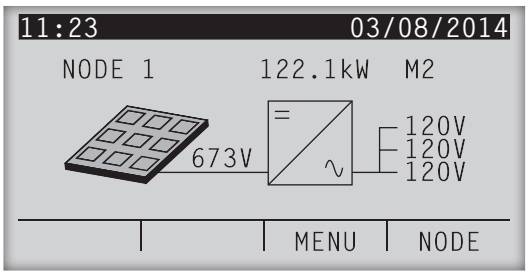
Red LED

On: Alarm set off which shuts down the inverter.

Special combinations

Rapid flashing of all three LEDs: Fatal error status.

16.2. Display



The current date and time on the top line. The internal clock automatically changes the time from summer to winter and vice versa.

The node number for which data is being viewed appears beneath the top line on the left.

The top right shows the number of the power module that is acting as master (in this example it is module 2).

The central section provides instantaneous PV array voltage, power fed in by the inverter and output voltages.

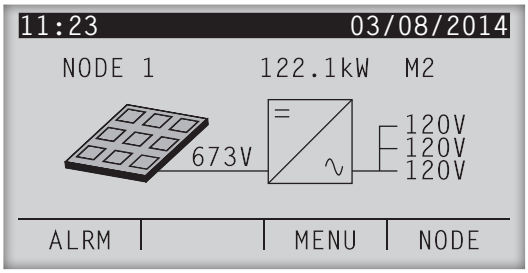
The bottom line displays the functions for each of the keys.

If the inverter is manually shut down, the display will read "STOPPED" instead of displaying the power fed in by the inverter.

In the initial screen, in normal operation, the keypad functions are as follows:

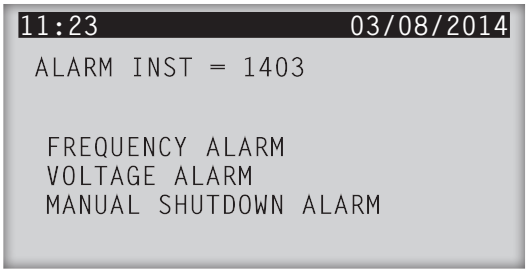
^	Manual shutdown or start, depending on the current status of the inverter.
v	Main menu access.
OK	Change node.

If there are any active alarms in the inverter, the bottom, empty box will flash "ALRM". By pressing the ESC key:



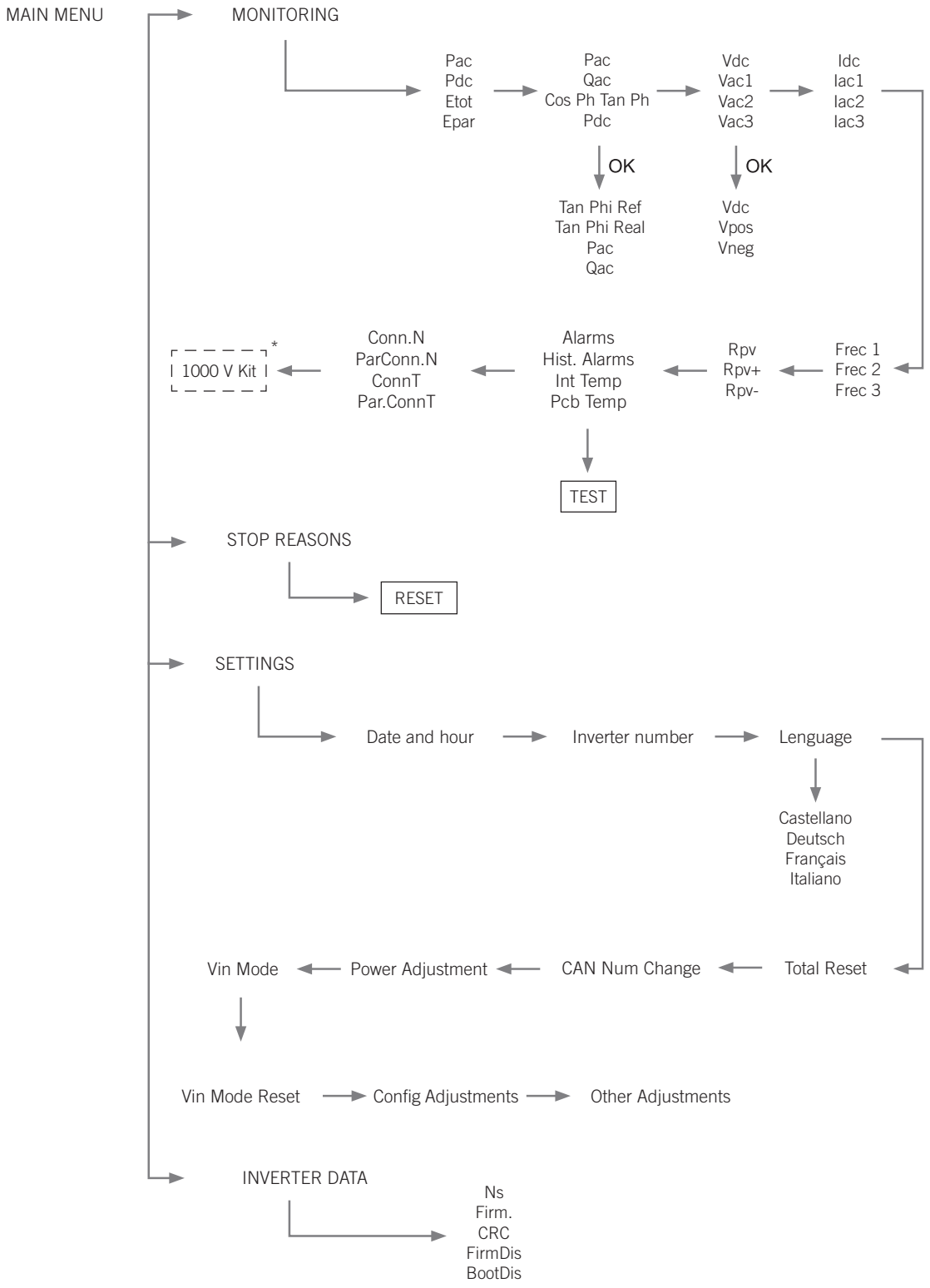
ESC	You can see all the active alarms by pressing it.

For example:



To exit this screen, press ESC again.

16.3. Menu structure

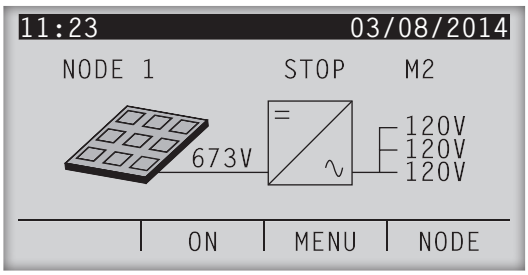


* optional.

16.4. Start/Stop

Manual shutdown or start-up of the inverter is carried out from the main menu display.

Pressing the ⌒ key changes the operating status to stop and vice versa.



16.5. Main menu

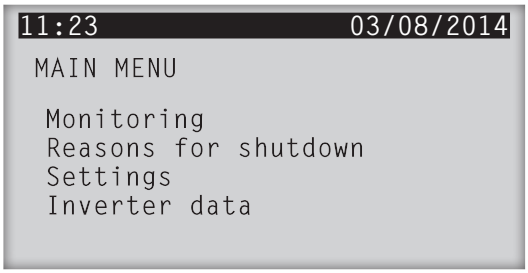
The main menu contains the following submenus:

Monitoring. This displays the main internal parameters and variables that indicate the operation status of the unit.

Reasons for shutdown. This option shows the reasons why the inverter was shut down the last five times.

Settings. This menu displays all the settings that affect the inverter.

Inverter data. This option offers inverter-specific data.



16.5.1. Monitoring

Press OK on the *Main menu > Monitoring* option.

See below for the structure and interpretation of the variables in this menu:

Screen 1

Pac	Power inverter is delivering into the grid, in kW.
Pdc	Power supplied by solar panels, in kW.
Etot	Total energy in kWh delivered by the inverter to the grid from the date it was manufactured. Recording the serial number of the equipment marks the start of this power log.
ParE.	Total energy in kWh delivered by the inverter to the grid since the last time the counter was reset.

Screen 2

Vdc	Voltage supplied by solar panels to the inverter.
Vac1	Inverter output voltage in phase one of the grid.
Vac2	Inverter output voltage in phase two of the grid.
Vac3	Inverter output voltage in phase three of the grid.

Screen 3

Idc	Current supplied by solar panels to the inverter.
Iac1	Inverter output current in phase one.
Iac2	Inverter output current in phase two.
Iac3	Inverter output current in phase three.

Screen 4

Frec1	Phase one frequency.
Frec2	Phase two frequency.
Frec3	Phase three frequency.
Cos.Phi	Cosine of Phi. Cosine of the phase shift angle between grid voltage and current supplied by the inverter.

Screen 5

Rpv Impedance of the entire PV array to ground.

Rpv+ Impedance of the positive pole of the PV array to ground.

Rpv- Impedance of the negative pole of the PV array to ground.

Screen 6

Alarms Status of inverter alarms.

- **0000H** No alarms.
- **0001H** Grid frequency out of range.
- **0002H** Grid voltage out of range.
- **0004H** PI current saturation.
- **0008H** Reset.
- **0010H** RMS overload at output.
- **0020H** Temperature alarm in the power electronics.
- **0040H** Hardware fault. Synchronization fault.
- **0080H** Instantaneous overload at output.
- **0100H** AC short-circuit protection.
- **0200H** DC circuit protection.
- **0240H** Fault in the DC isolating switch control.
- **0400H** Insulation fault.
- **0800H** Power electronics fault.
- **1000H** Manual shutdown alarm.
- **2000H** Configuration change alarm.
- **4000H** Panel input overvoltage
- **8000H** Low voltage in the PV array.

Alarms Hist Alarms since the last connection. This value is reset each time the inverter is connected to the grid. It has the same code as the "alarms" variable.

TempInt Inverter power electronics temperature.

PCBTemp Inverter control electronics temperature.

Screen 7

Conn.N Number of grid connections made during all hours of operation.

ParConn.N Number of grid connections since counter was last reset.

- **ConnT** Number of hours the inverter has been connected to the grid.
- **Par.ConnT** Number of hours the inverter has been connected to the grid since the counter was last reset.

Screen 8

System status This parameter can have three states:

- **Initial status** In start-up status.
- **Operational status**
- **Error status**

MPPT Power Power injected by the power module configured as master.

Slave Power Power injected by the power module of the node being measured.

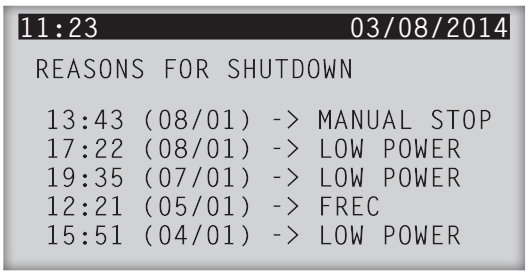
Total Power Power injected by all the power modules configured in this master-slave system.

Screen 9

This screen displays a histogram of the power output from each of the electronics blocks configured in the master-slave system.

16.5.2. Reasons for shutdown

This menu shows the last five inverter shutdowns, with reasons and corresponding date and time.


11:23 03/08/2014
REASONS FOR SHUTDOWN
13:43 (08/01) -> MANUAL STOP
17:22 (08/01) -> LOW POWER
19:35 (07/01) -> LOW POWER
12:21 (05/01) -> FREC
15:51 (04/01) -> LOW POWER

Meaning of reasons for shutdown:

VDC	High input voltage from the panels.
FREC	Incorrect grid frequency.
VAC	Incorrect grid voltage.
VARISTORS	Varistor fault.
INS.FAILURE	DC insulation fault.
RMS CURRENT	Continuous overvoltage on AC output.
TEMPERATURE	Excess temperature in the power electronics.
CONFIG	Shutdown for configuration change.
MANUAL STOP	Manual shutdown.
MIN VPV	Low panel input voltage.
HW_DESCX	Shutdown due to a failure in the master.
PEAK.CURR	Voltage surge on AC output.
FIRMWARE.CH	Shutdown due to firmware change.
ADC READING	AD converter (internal) reading fault.
LOW POWER	Insufficient solar radiation. Does not trigger alarm.
DC.PROT	Input fuse fault.
AUX.TEMP	Redundant temperature sensor fault.
AC.PROT	AC Protection.
AC.MAG.PROT	AC thermomagnetic circuit breaker error.
CONTACTOR	Contactor failed to close.
WD.RESET	Stopped for Watch Dog reset (internal).
ADC LAT	Converter (internal) fault.
FATAL ERROR	Power electronics fault.
FAULT(1)	Power electronics fault.
FAULT(2)	Power electronics fault.
FAULT(3)	Power electronics fault.
CURR.PI.SAT	PI current saturation (internal).
RED	The redundant system has caused a shutdown.

16.5.3. Settings

Date and Time

From this menu you can change the date and time. The internal clock automatically changes the time from summer to winter and vice versa.

Inverter number change

From this menu you can assign the node number to the inverter. This is required for configuring communications.

Language

With this option, you can select the display language.

In the main screen, press the "down" key (an arrow pointing downwards). Main menu access.

Press OK on the *Main menu > Settings > Language* option.

Press the ∨ button to scroll through the various languages

Grid quality

In this menu, you can change the grid quality parameters. This menu is only active after the security code has been input.

Ground connection

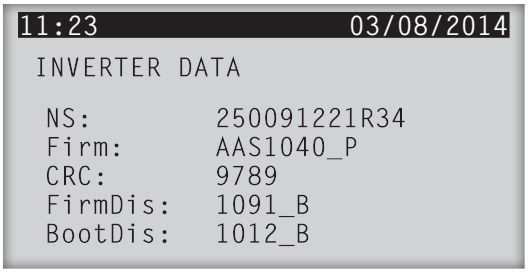
Through this option, you can change the type of grounding for the PV array. This menu is only active after the security code has been input.

Connection time

This menu allows you to modify the delay before the inverter connects to the grid. This menu is only active after the security code has been input.

Total reset

With this option, the user can reset all inverter counters. This menu is only active after the security code has been input.



Other adjustments

Internal adjustments are only accessible after the security code has been entered.

Change NumCAN

From this menu you can change the electronics blocks' node number. This is needed for configuring the electronics blocks. Because this action involves hardware-altering operations, instructions for changing the node number are given at the unit's set point.

See Section *"19.5.1. CAN number setting of an electronics block"*.

16.5.4. Inverter data

This window displays inverter-specific data:

Serial Number (SN)	Number that identifies the inverter.
Firmware Version (Firm)	Shows the name and version of the inverter firmware.

Display firmware version (FirmDis)	Shows the name and version of the inverter display.
Boot version of the display (BootDis)	Shows the name and version of the display Boot.

16.5.5. Change inv. no.

From this menu you can assign the inverter a number. This is required for configuring communications.

Use the ∧ and ∨ keys to change the inverter number. Press OK to confirm the number selected.

17. Shutting down the unit

This section describes the procedure to shut down the unit. If you wish to work on the modules, these instructions must obligatorily be carried out in the order shown here to remove power.

It also explains the different actions which cause the unit to shut down and their scope.

See Section *"3. Safety"* before operating the equipment.

The inverter's electro-mechanical elements have a limited number of operating cycles for on-load disconnection. A large number of disconnections or instantaneous trips leads to higher wear in them, which can lead to undesirable, early deterioration.

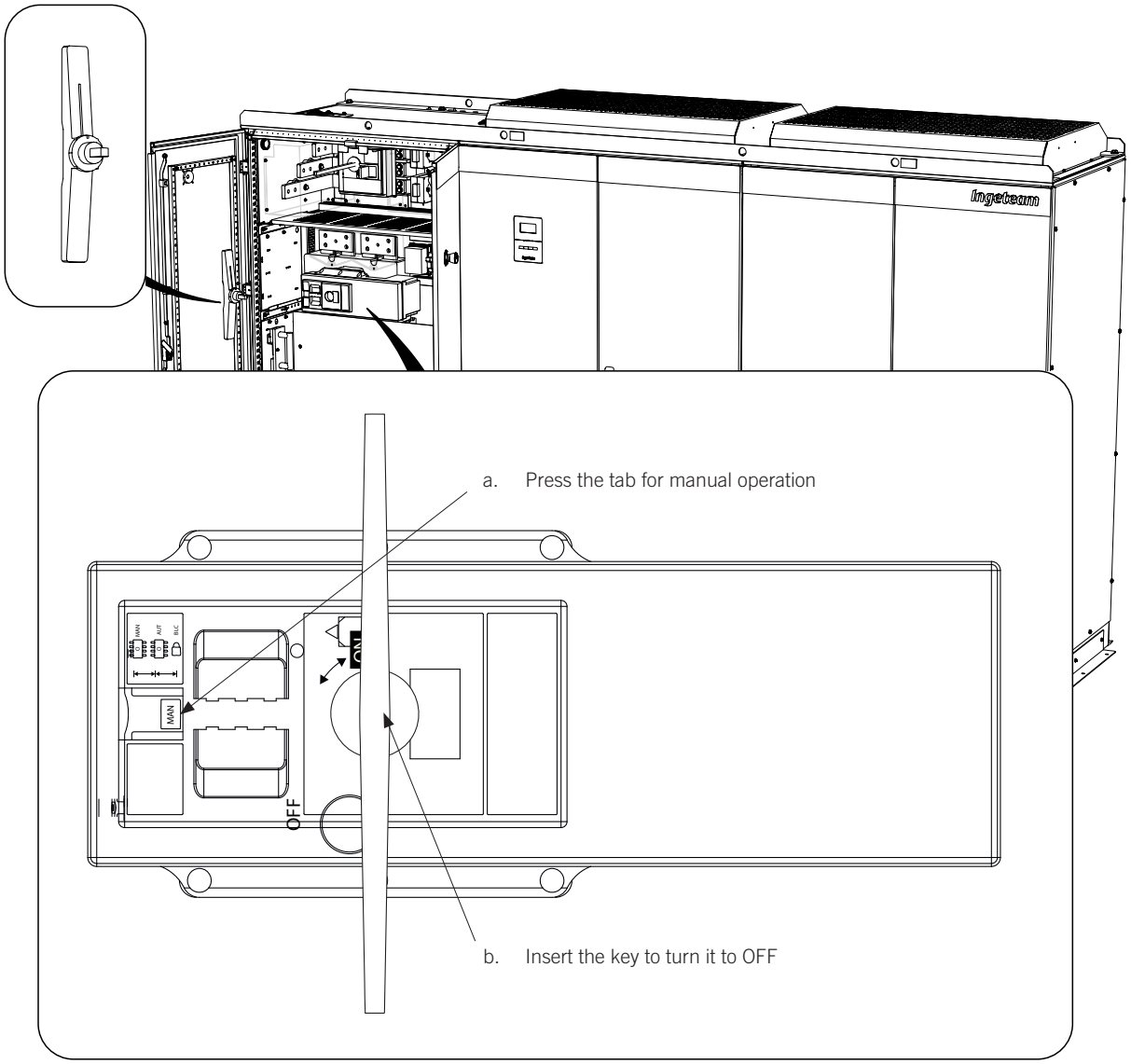
Following the steps below gives safe, no-load disconnection, maximising the life of any electro-mechanical components in the inverter.

17.1. Process of disconnecting the unit

To carry out any maintenance task on the unit involving access to the inside, it is necessary yo disconnect the unit and isolate any source of voltage. Proceed in the following order to disconnect voltage sources safely:

1. Stop inverter on the display (see Section *"16.4. Start/Stop"*). All power modules must be disconnected, cutting off the supply of AC power.
2. If the unit has an AC disconnection control on the outside of the DCAC supply module, switch it to Off and lock it using a consignment lock. Open thermomagnetic circuit breaker Q4. A sign reading "Do not touch. Personnel at work" will be posted. Disconnect the voltage at the main inverter AC supply, located in the DCAC supply module. This action will need to be carried out by means of an element external to the unit. If it is not possible to disconnect the main AC supply from outside the unit, bear in mind that the AC connection plates will be live and work must be carried out using the appropriate PPE (dielectric gloves suitable for the working voltage, face shield, safety boots, working clothes, recommended fireproof clothes, etc.).
3. Press the emergency stop button. Pressing the emergency stop button causes the motorised DC isolating switch to open. Check that the DC isolating switch changes to the Off position after two seconds. If the isolating switch has not moved automatically to the Off position, operate it manually.

To operate the DC isolating switch, push the latch on the yellow plunger so that the latter slides towards the left, providing access to the housing for the rotary knob.



The rotary knob is on the left door of the DCAC supply module. Once the isolating switch is in the Off position push the plunger to the locking position (BLC) and insert the padlock. Personnel at work" will be posted.

4. Isolate the PV array powering the DCAC supply module from the outside.

   If the PV array powering the DCAC supply module cannot be isolated from the outside. It should be taken into account that the feed of the DC circuit breakers will be live and work must be carried out with the appropriate PPE (i.e., dielectric gloves appropriate for the operating voltage, face shield, safety boots, work clothes, fire-retardant clothing recommended).

5. Open the FN intake neutral fuse located in the upper part of the supply module.
6. Open thermomagnetic circuit breakers QM and QAUX.
7. Check that there is no voltage by using an appropriate multimeter. Use the PPE listed in the PPE section.

Verify the absence of voltage before performing any operation. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

17.2. Shutting down the inverter from the display

It may be necessary on occasions to carry out an isolated unit shutdown without following the protocol explained under point *"17.1. Process of disconnecting the unit"*. This must only be carried out when you do not wish to gain access to the inside of the inverter and you wish to switch the inverter to shutdown status, stopping delivering power to the grid.

To do this from the display, switch the inverter to shutdown status. The inverter will stop switching and disconnect the AC grid connection contactor in each power module.

This shutdown procedure does not guarantee complete disconnection of all sources of voltage connected to the unit, hence accessing the inside of the unit after performing this shutdown is prohibited. If you wish to gain access to the inside of the inverter, follow the procedure in Section *"17.1. Process of disconnecting the unit"*.

17.3. Inverter shutdown from the emergency stop button

For the case of an unexpected situation, these units have an emergency stop button. When pressed, the following actions are performed:

1. If the unit is connected to the grid, the inverter will stop switching and disconnect the AC grid connection contactor in each power module.
2. Opening of the motorised DC isolating switch. Any PV array input voltage will be disconnected.

It will not be possible to start inverter operation again until the emergency stop button has been returned to its original position.

The inverter's electro-mechanical elements have a limited number of operating cycles for on-load disconnection. A large number of disconnections or instantaneous trips leads to higher wear in them, which can lead to undesirable, early deterioration.

This shutdown procedure does not guarantee complete disconnection of all sources of voltage connected to the unit, hence accessing the inside of the unit after performing this shutdown is prohibited. If you wish to gain access to the inside of the inverter, follow the procedure in Section *"17.1. Process of disconnecting the unit"*.

17.4. Inverter shutdown by opening a door

These units have a safety system whereby, using a limit switch, the unit switches to shutdown status and the PV array is disconnected automatically when a door is opened in the operating unit.

Until it has been ensured that all the unit's doors have been closed correctly, it cannot be returned to the operating condition again.

Ingeteam accepts no liability for the consequences of tampering with the safety system.

This shutdown procedure does not guarantee complete disconnection of all sources of voltage connected to the unit, hence accessing the inside of the unit after performing this shutdown is prohibited. If you wish to gain access to the inside of the inverter, follow the procedure in Section *"17.1. Process of disconnecting the unit"*.

18. Preventive maintenance

The recommended preventive maintenance tasks must be carried out at least **annually**, except for general inspection and checking the fans and filters and housing condition, which must be done **monthly**.

See Section *"3. Safety"* before operating the equipment.

18.1. Safety conditions

All maintenance work will be carried out with the unit disconnected from the supply.

Verify the absence of voltage before performing any operation. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

To disconnect the unit, follow the instructions in Section *"17. Shutting down the unit"*.

To connect the unit, follow the instructions in Section *"15.3. Start-up"*.

The various maintenance tasks must be performed by qualified personnel.

18.2. General review

Make a visual inspection of the interior state of the individual modules.

Check for parts that are damaged or in poor condition, having suffered any of premature degradation due to overheating, rust or other external aggressions.

Check inside the unit is free from dust and other elements. If there is any dirt inside clean it with a vacuum cleaner.

18.3. Status of the housing

A visual check of the status of the housing must be performed, verifying the condition of locks, doors and handles and the unit fixings at both lower and, if any, upper anchorage points. In addition, the condition of the housing must be checked for dents, scratches or rust that might degrade the unit or cause it to lose its protection classification. If this type of defects are noticed, the parts affected must be substituted.

Check the condition of the cables entries and ensure they have the same degree of protection as the unit itself.

Check that there is no moisture inside the unit. If moisture exists, dry before making electrical connections or starting up the unit.

18.4. Status of cables and terminals

Check the correct path of the cables so they do not come into contact with live parts.

Check for insulation faults and hot spots by checking the colour of the insulation and terminals.

18.5. Tightness of strip fasteners and power cables

The correct tightness of the unit power cables needs to be checked annually. Unit transport and operation produce vibrations which can lead to variations in the indicated tightening torques.

The following table shows torque as a function of bolt size:

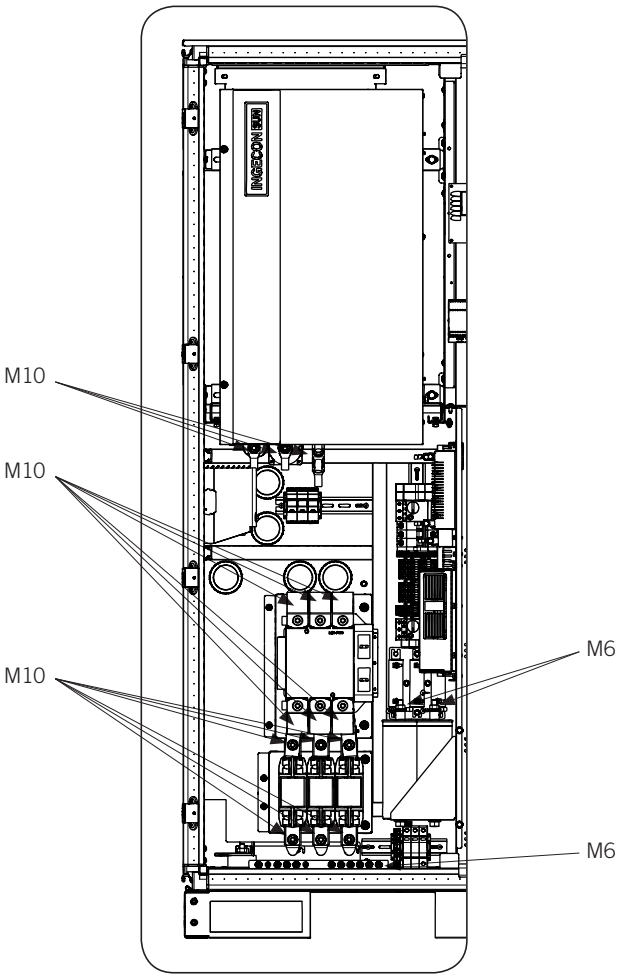
Thread size	Tightening torque
M6	8 Nm
M8	19 Nm
M10	39 Nm

Thread size	Tightening torque
M12	65 Nm

As per DIN 13.

Check the following bolts using a correctly calibrated torque measurement tool:

- DC input and AC output connections from the unit (M12).
- Connections between plates and DC isolating switches and/or AC thermomagnetic circuit breakers (M10).
- Connections inside the power module (see the figure below).



Power module

18.6. Plates

Visually check that the AC and DC feed connection plates, as well as the plates in each power module, meet safety clearances and maintain their initial electrical properties and are free of rust and humidity.

18.7. Cooling system

18.7.1. Status of unit fans

Checking the status of exhaust fans, cleaning and replacing them if necessary.

The useful life of the fans is 8 years, so they must be replaced after this time even if they seem to be functioning normally.

18.7.2. Replacement of fans

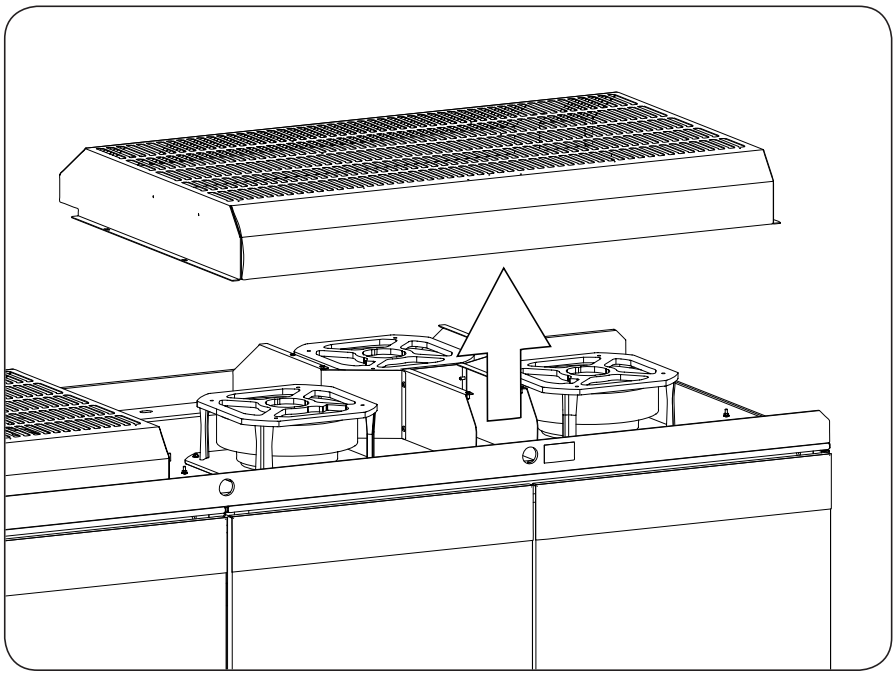
At least two people are needed to replace a fan.

In order to keep the nuts and bolts of the unit in good condition it is important to make sure there is no dirt or shavings in the threads when screwing them in and apply a suitable lubricant.

If the fan has come to the end of its life or is malfunctioning, it should be replaced. To do this, follow the following steps.

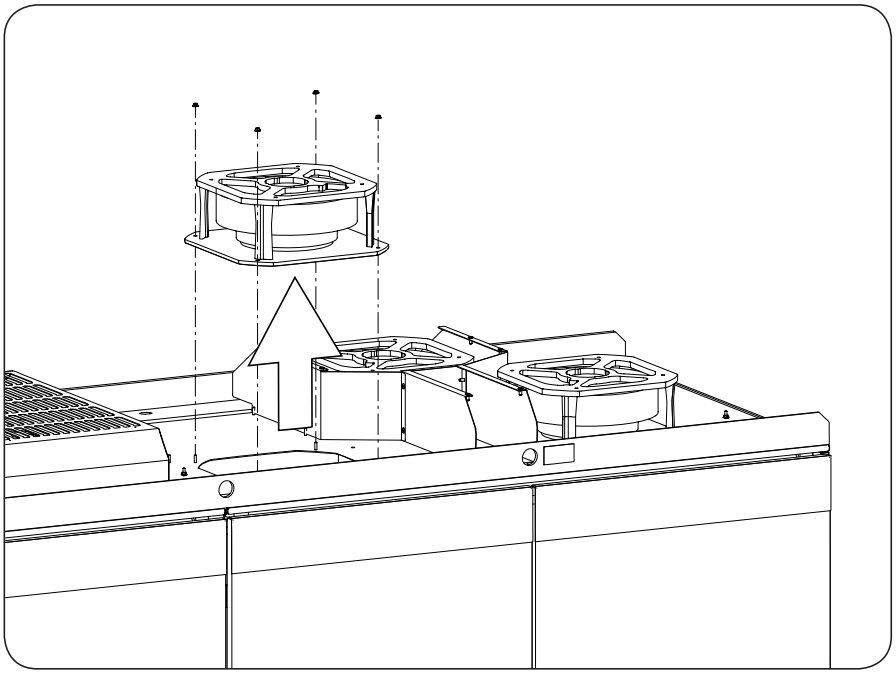
Disassembly

1. With the unit powered down, remove the fixing screws from the fan protection cover.



2. Disconnect the aerial connector of the fan to be replaced.

3. Remove the four screws fixing the fan to the roof and remove the fan to be replaced.



Assembly

1. Place the new fan in its housing, bearing in mind that the fan cable should be as close as possible to the cable entry into the inside of the unit.
2. Connect the aerial connector of the fan to be replaced.
3. Secure the fan to the ceiling with the four fixing nuts.
4. Install the fan cover and tighten the four screws.
5. Check that the fan is correctly positioned and there are no air leaks.

18.7.3. Cleaning grids and cooling filters

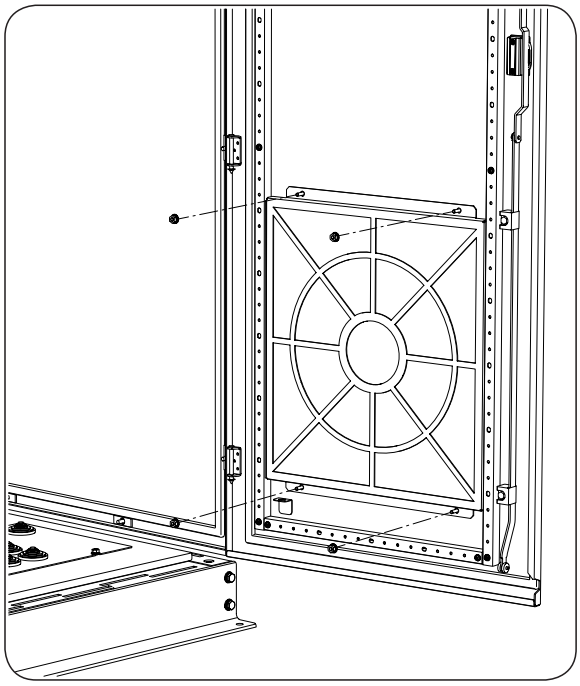
Check the state of the ventilation grids and filters. Accumulated dust and dirt may adversely affect the cooling ability of the fans and result in overheating of the equipment.

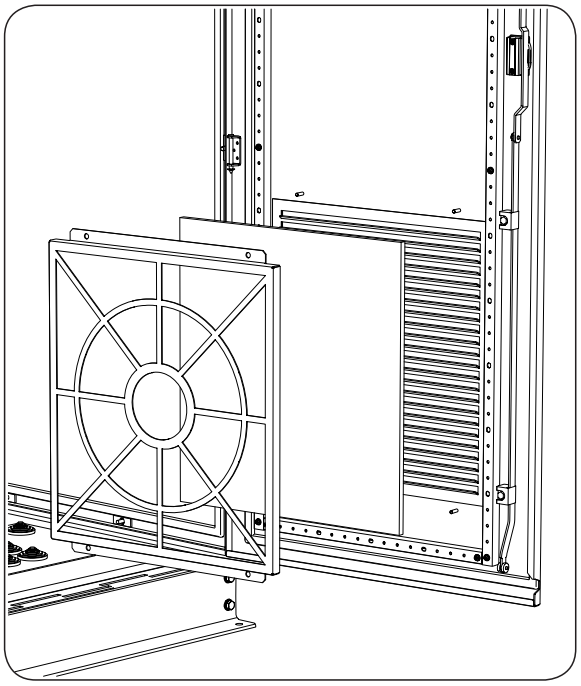
At regular one month intervals accumulated dust and dirt must be removed from the outside of the front and rear grids using a vacuum cleaner.

These points will apply to the inlet filters in the cabin or enclosed location where the unit is installed.

Air inlet grids and filters

To gain access to the ventilation filters located in the front of each door, proceed as shown in the following figures.





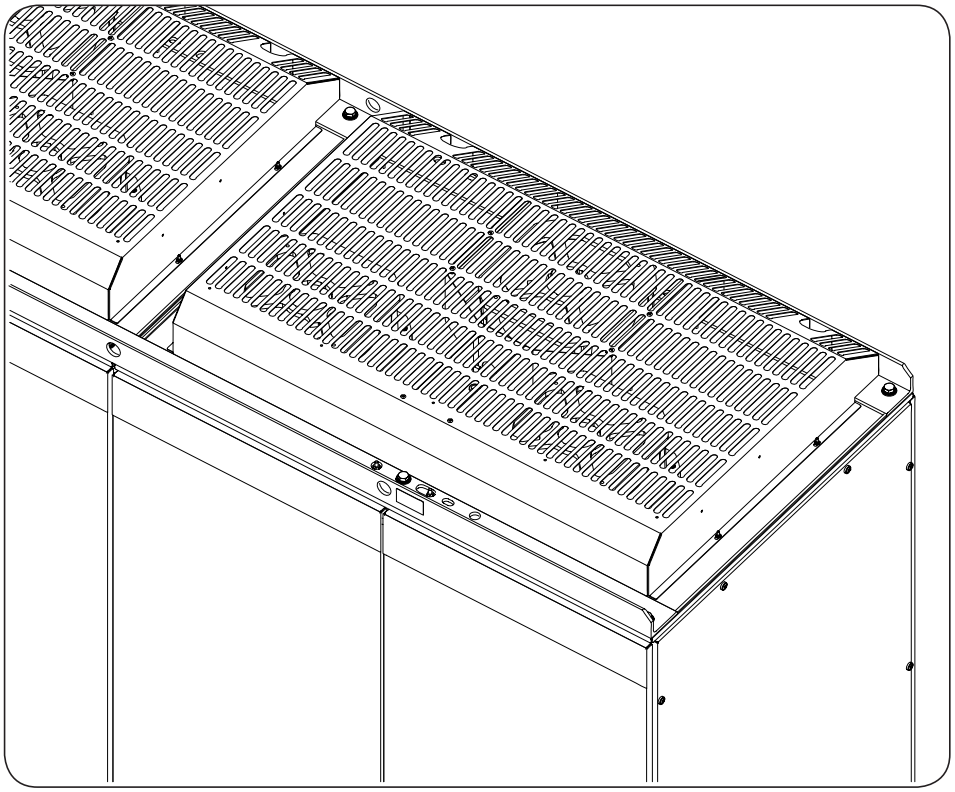
With a moderately dirty, dry filter, lightly tap until the dirt has been removed.

If the dirt does not disappear, wash in water at 40 °C.

If the filter is soiled with grease or oil, replace it with a new one.

Air outlet grids

Vacuum and clean the air outlet grilles at the top of the unit.



If any of them are damaged or worn, replace them.

18.8. Relay status

To find the different components listed below, consult Section *"2.7. Location of components"*.

The unit contains several relays which must be checked annually. Check visually, always with no voltage on the unit, that there is no darkening of the housing caused by heating and that the stand-by position is correct.

They must be replaced if any anomaly is observed.

The relays described below refer to the basic configuration of these units. If the unit incorporates optional kits these may incorporate additional relays, which must also be checked.

Power modules

K2n, K3n and K4n.

Electronics block

U31, U37, U39, U40 and U46.

18.9. Status of the fuses

To find the different components listed below, consult Section *"2.7. Location of components"*.

Perform an annual inspection of the state of the various fuses protecting the equipment. The fuses described below refer to the basic configuration of these units. If the unit incorporates optional kits these may incorporate additional fuses, which must also be checked.

DCAC supply module

Fuses for the common mode condenser filter (F9 and F10).

Ground connection fuse, only in grounded units (F17).

DC supply fuses (the number of fuses depends on the number of power modules and the type of grounding of the unit).

Power modules

AC fuses (FACn1, FACn2 and FACn3).

19. Troubleshooting

This is a troubleshooting guide for the installation of the inverter.

It also explains how to perform simple operations such as component replacement and unit configuration.

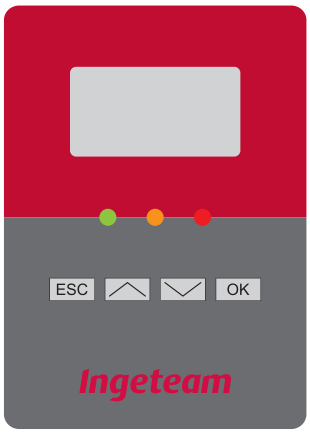
Troubleshooting for the inverter must be performed by qualified personnel in compliance with the general safety instructions in this manual.

See Section *"3. Safety"* before operating the equipment.

To find the different components listed below, consult Section *"2.7. Location of components"*.

19.1. LED messages

Some of the LEDs indicate some kind of problem in the PV installation.



Display

19.1.1. Green LED

This is the LED that should light up in normal start-up and operating conditions, while the others remain off. It has three modes:

Slow flashing

Standby due to low solar radiation. Flashing every 3 seconds. This alarm is triggered when the PV array does not receive enough solar radiation to supply the minimum voltage required by the inverter to inject power. This occurs commonly between sunset and sunrise, or at times when rain, clouds or other atmospheric phenomena produce overcast conditions above the PV array.

It will also flash if one of the power modules network is not connected to the grid due to non-availability of power at the PV array.

If this situation occurs on a day which is not particularly dark, check that the panels are clean and properly installed.

Fast flashing

This type of flashing indicates that the PV array is feeding the right amount of voltage to the inverter and it is about to start up. In this state, the inverter checks the grid parameters to feed current into the grid at the latter's precise voltage and frequency. This process takes about 5 minutes (configurable).

Steady light

Inverter connected to the grid. All power modules are connected to the grid.

19.1.2. Orange LED

This LED indicates that alarms have been set off in the inverter. It does not involve unit shutdown.

Fast flashing

This flashing indicates that an alarm has occurred in the inverter, but the anomaly in the operation does not require stopping the inverter. An alarm of this type is the power limitation alarm. It may be that the inverter is in self-limiting mode because it has reached the maximum permissible temperature.

In this situation, check that the fans are running, that the air inlets and vents are free from obstacles, that the grids and filters are not unduly dirty and that there are no sources of intense heat near the inverter. If the problem persists, contact Ingeteam.

19.1.3. Red LED

This LED indicates that alarms have been set off in the inverter. It involves a unit shutdown. If the unit is not connected to the grid, it will not be possible to start it up until the alarm has been eliminated.

Steady light

The inverter shuts down. This flashing indicates that an alarm has occurred in the inverter which requires it to shut down.

The alarm or combination of alarms affecting the unit can be identified from the display. To do this, press the ESC on the main menu when ALRM appears above the key. By choosing the various nodes, you can identify the alarms affecting each power module.

The alarm code shown by the display is the hexadecimal sum of the existing alarms. Example:

Code	Alarm
0001H	Grid frequency
0002H	Voltage
0003H	Grid frequency + voltage

The alarm codes are listed in Section *"19.2. List of alarms and reasons for shutdown"*.

1000H Manual shutdown. The unit has been stopped manually. Check that the unit is not in manual shutdown via the display and that all doors are properly closed.

0001H Grid frequency out of range.

0002H Grid voltage out of range.

The most likely cause is a network power failure. When power returns, the inverter will restart. If after 10 minutes have passed this does not occur, check the connections to the grid.

If the grid has the appropriate grid quality parameters, check the grid connections.

If the problem persists, contact Ingeteam.

0400H Insulation fault in DC circuit.

There are three possible causes:

- There is an insulation fault on the panel circuit.
- The ground connection fuse has blown.
- One of the unit arresters has tripped.

0020H Temperature alarm in the power electronics.

The temperature of the unit is too high and has stopped feeding current to the grid. When the temperature drops, the unit will reconnect.

An insulation fault can pose a hazard to personnel.

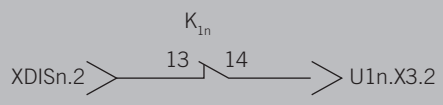
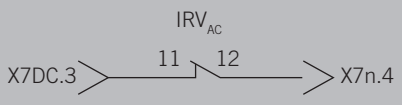
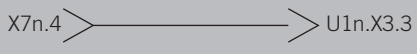
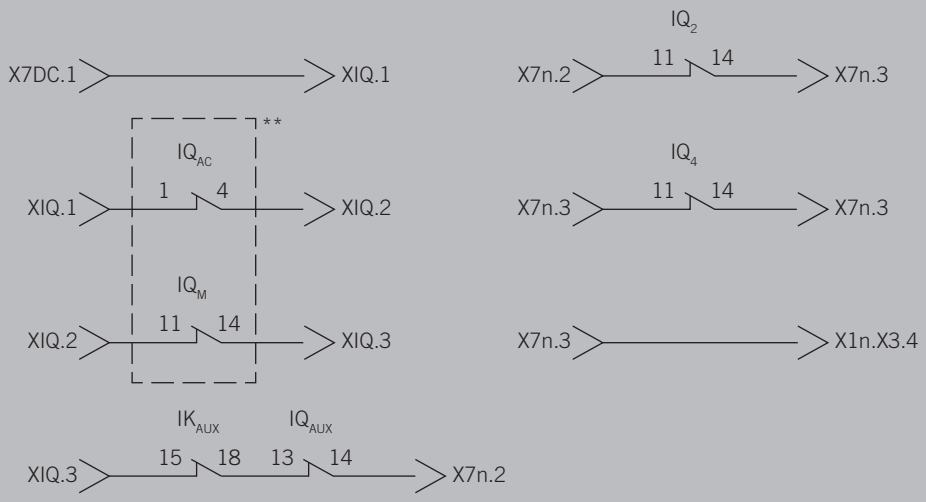
The repair of an insulation fault must be carried out by qualified personnel.

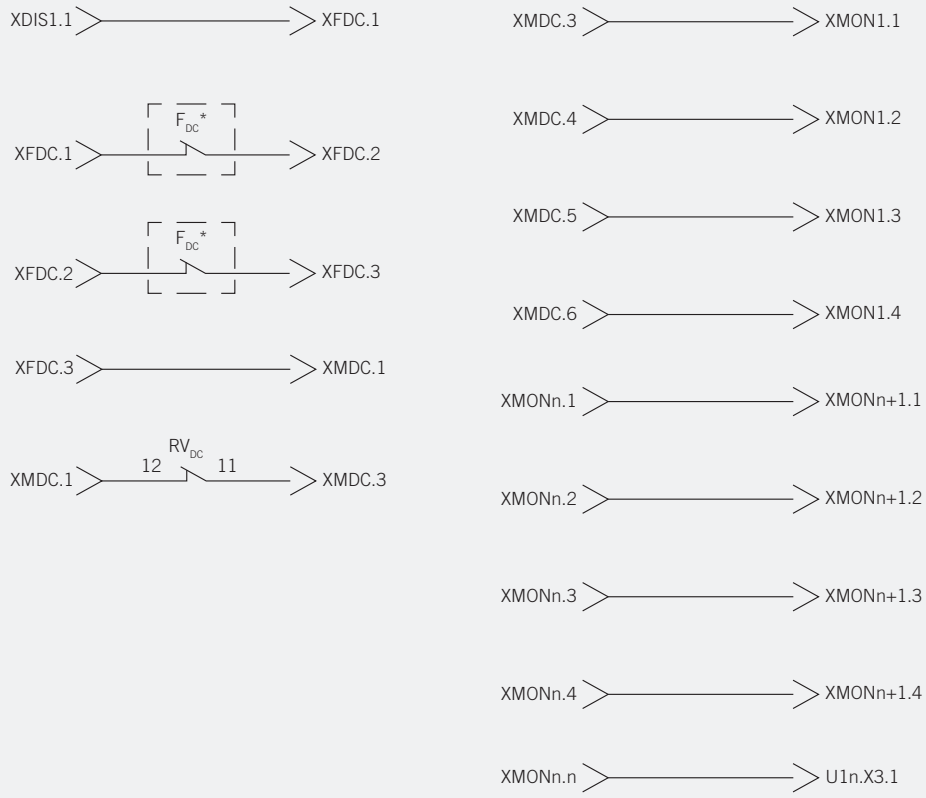
19.2. List of alarms and reasons for shutdown

The following table details the possible reasons for shutdown related to each alarm.

Code	Alarm	Reason for shutdown	Description
0001H	Grid frequency out of range	Grid frequency out of range	The measured grid frequency is outside the specified limits
0002H	Grid voltage out of range	Grid voltage out of range	The measured grid voltage is outside the specified limits
0004H	Control current saturation	Control current saturation	Unit control current saturation
0008H	Reset	Reset	Indicates that the inverter has reset, inverter firmware fault
0010H	Effective grid current	Effective grid current	RMS current exceeds maximum allowed
0020H	Temperature	Power electronics temperature	The temperature of power electronics exceeds 80 ºC.
		Auxiliary temperature sensor	The auxiliary temperature sensor has triggered an alarm
0040H	Hardware fault	Error reading ADC	A higher than normal reading of the top ADC has been detected on an unexpected input. Synchronism or auxiliary power supply has been lost.
		ADC latency	Internal error of the analogue to digital converter
		Master-slave	Error on master-slave system or optical fibre
		Motorised DC isolating switch	The status of the motorised DC isolating switch is not correct for the current inverter status
		Fault in LVRT kit	Error in the optional hardware necessary to comply with the regulations on withstanding grid voltage drop outs
0080H	Instantaneous grid current	Instantaneous grid current	Instantaneous current value out of range
0100H	AC protection	Varistors	Error in AC varistors
		Contactor	The state of the contactor is not correct for the current inverter status.
		AC protection	Error in some of the AC protectors, arresters, fuses, etc.
0200H	DC protection	DC protection	Blown DC input fuses or DC arresters
0400H	AC insulation	AC insulation	Insulation fault in the PV array on inside the inverter
0800H	Branch fault alarm	Fault in branch no. 1	Fault in branch no. 1 of the power electronics
		Fault in branch no. 2	Fault in branch no. 2 of the power electronics
		Fault in branch no. 3	Fault in branch no. 3 of the power electronics
1000H	Manual shutdown	Manual shutdown	Manual shutdown due to the emergency push-button, the display or communications or a badly closed door on the unit.
2000H	Configuration	Configuration	Shutdown due to a change in firmware
		Firmware	Shutdown due to firmware load
4000H	High input voltage	High input voltage	High DC input voltage
8000H	Panel voltage	Low input voltage	Shutdown due to low input voltage
		Hardware fault	Reason for internal shutdown, hardware fault
		Low power	Shutdown due to low power, (typical at nightfall)
7FFFH	Fatal error	Fatal error	Due to five consecutive branch fault errors, consecutive contactor shutdowns, an error in any of the fans or high temperature fault

19.3. Inverter alarms due to protections

Code	Description
0020H	Temperature alarm in the power electronics. The temperature of the unit is too high and has stopped feeding current to the grid. When the temperature drops, the unit will reconnect.
0100H	AC circuit protection. This alarm goes off when an AC protection element is triggered. The items monitored are: Q_{AC}, Q_M, Q_{AUX}, Q_4, Q_{2n}*, R_{VAC}, K_{1n}* Which correspond to the monitoring of the protections for the filters and AC intakes and AC arresters and contactors. * n refers to the power module number (from 1 to 4). In normal operation, all contacts should be closed, except for the contactor circuit. Check the signalling circuit to see where it is broken. The causes may be broken cables in the circuit, a triggered protection, fused arresters or a connector out of its base. There are three monitoring circuits which need to be checked. **Circuit 1**  **Circuit 2**   **Circuit 3**  ** optional, depending on the configuration of the unit.

Code	Description
0200H	DC circuit protections. This alarm goes off when a DC protection element is triggered. The element being monitored are the DC arresters (RV_{DC}). Depending on unit configuration, the PV array grounding kit is also monitored. In normal operation all contacts must be closed. Check the signalling circuit to see where it is broken. The causes may be broken cables in the circuit, a triggered protection, fused arresters or a connector out of its base.  * optional, see Section *"12. Connection options"*.
4000H	Overvoltages in the panel inputs. This alarms indicates an out-of-range voltage at the PV input. A voltage greater than 1000 VDC will cause the equipment to shut down. Voltages greater than 1000 VDC will damage the equipment.
8000H	Very low voltage on the input from the panels. This alarms indicates an out-of-range voltage at the PV input. The equipment will be on standby until the panel voltage reaches the necessary value for a connection.

19.4. Action protocol for responding to incidents

If the unit should stop interacting with the network due to the emergence of issues relating to the installation and/or the inverter, the fastest way to resolve the issue is as follows:

1. Check on the display the alarm and the reason for shutdown reported by the unit.

   Search in this guide's index to see if the alarm or reason for shutdown is indicated. If it is covered, proceed to step 2; if on the contrary it is not covered, take note of the unit's serial number and contact Ingeteam's telephonic technical service, the number of which is listed on a sticker on the document pocket behind the door of the module in which the display is fitted.

2. Disconnect the unit from the supply. See Section *"17. Shutting down the unit"*.
3. Open the unit and find the section in this guide that deals with the alarm or reason for shutdown recorded in the first step.
4. Use a category III, 1000 volt multimeter capable of measuring continuity, resistance and capacitance, and carry out the checks listed here.
5. If unable to solve the problem using this guide, take note of the unit's serial number and contact technical service.

Below is a list of possible reasons for shutdown, their associated alarms and troubleshooting guidelines. If more than one alarm takes place, the alarm on the display will be the sum of all active alarms.

Example:

Code	Alarm
0001H	Grid frequency
0002H	Voltage
0003H	Grid frequency + voltage

19.4.1. Voltage and/or frequency out of range

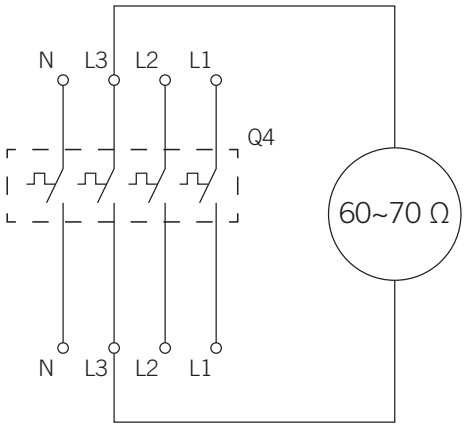
One reason for shutdown associated with out-of-range voltage and/or frequency features the alarm codes listed below:

Code	Alarm	Reason for shutdown	Description
0001H	Grid frequency	Grid frequency	Grid frequency out of range
0002H	Voltage	Voltage	Voltage out of range
0003H	Grid frequency + voltage	Grid frequency + voltage	Grid frequency out of range + Voltage out of range

In the event of an 0001H and/or 0002H alarm, you must check the status of the Q4 thermomagnetic protection and all the wiring associated with it.

This check requires verifying the correct status of the following areas of the unit:

1. Check that intake thermomagnetic circuit breaker (Q4) is in the ON position.
2. If Q4 is ON, the next step is to verify that there are no errors in the wiring (loose or broken cables, etc.).
3. Check that the Q4 thermomagnetic circuit breaker is not damaged. With Q4 switched ON, measure the flow resistance offered by Q4 for each phase. The resistance for each of the phases must be within the 60 to 70 Ohm range. The following figure details the test to be performed.



The figure has verified the resistance of phase 1, L1. It will also be necessary to check L2, L3 and neutral.

4. Check for continuity in the VAC intake circuit between contactor K1n and electronics block U1n.

- K1n.2 – Q4.1
- K1n.4 – Q4.3

- K1n.3 – Q4.5
- Q4.2 – U1nXAC.4
- Q4.4 – U1nXAC.3
- Q4.6 – U1nXAC.2
- XDISn.7 – U1nXAC.0

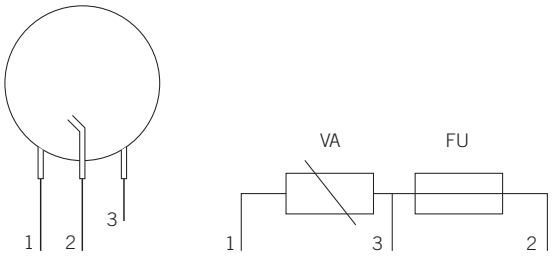
5. Check for continuity between the terminal on the electronics block and the intake board in each power module:

- J8.2 – U1nXAC.1
- J8.1 – U1nXAC.2
- J7.1 – U1nXAC.3
- J6.1 – U1nXAC.4

6. Visually check varistors RV1, RV2 and RV3 of the intake board. Check that the thermal fuse is not damaged.

The intake board varistors comprise a thermal fuse (FU) and a varistor (VA). The way to check that the varistor is operating correctly is to perform the checks listed below:

- Between pins 1 and 2, you must get a high impedance reading in the kOhm range.
- You should have an impedance of approximately 0 Ohms between pins 2 and 3.



7. If all the above checks are correct and a 0002H alarm persists when the unit is powered on again (see Section *"15.3. Start-up"*), check that the impedance of each phase at the output of each power module and electronics block is high with respect to ground. To perform this check, measured between each of the phases of unit and grounding plate of the power module in question, with no voltage on the unit.

If the alarm persists, consult Ingeteam.

19.4.2. Temperature

Code	Alarm	Reason for shutdown	Description
0002H	Temperature	Power electronics temperature	The power electronics exceeds 80 ºC
		Auxiliary temperature sensor	The auxiliary temperature sensor has triggered an alarm

In the event of a shutdown due to *Temperature*, the first step is to check if 0020H alarm is still active. If so, check the temperature of the unit's radiator via the display menu (see Section *"16.5.1. Monitoring"*):

MONITORING → TempRad

If the temperature displayed is close to or above 80 °C, the unit has failed to inject power as a precaution against a potentially damaging radiator temperature for the unit. The inverter will remain in this state until the radiator has cooled, and then it will reconnect to the network.

If the problem occurs frequently, you should check the cooling system (see Section *"18.7. Cooling system"*) of the inverter.

If the temperature shown is less than 60 °C and the alarm persists, the problem could be in one of the thermal switches built into the inverter in the radiator of the electronics block.

If the displayed temperature is abnormally low (compared to room temperature), the root of the problem could be with the NTC built into the inverter.

Checking the thermal switches

Each electronics block has 3 thermal switches to prevent overheating in the unit.

To check the correct status of the thermal switches, measure continuity between terminal U1nX3.8 on the terminal strip of the electronics block and terminal J19.2 on the intake board.

If you do not have continuity, you should contact technical support.

Checking the NTC

To check the correct status of the NTC of the electronics block you will need to access the J18 terminal of the intake board. This terminal is located underneath the control card.

The procedure to check the correct status of the NTC is as follows:

1. With no voltage on the unit, disconnect the cables from J18.1 and J18.2.
2. Measure the impedance between these wires with the aid of a multimeter. The resistance measured should be approximately 5 kOhm at 25 °C ambient temperature.
3. Reconnect cables J18.1 and J18.2 and measure the impedance in the connector. The resistance measured should be approximately 1 kOhm at 25 °C ambient temperature.

Should any anomaly be found in the inverter's NTC, contact technical support.

19.4.3. AC circuit protection

Code	Alarm	Reason for shutdown	Description
0100H	AC protection	AC protection	Error in some of the AC protectors, arresters or in the auxilliary relay.

In the event of an *AC Protection* reason for shutdown, check the status and monitoring of the unit's AC circuit protections.

Check that all protections (QAC, QAUX, QM, Q4 and Q2n) are On.

If the AC circuit protection status is correct, proceed to verify their monitoring. To do this, you will need to check the monitoring branches in accordance with the diagram in Section *"19.3. Inverter alarms due to protections"* for the 0100H alarm.

After checking the status and monitoring of the AC circuit protections check the status of the AC arrestors.

If the alarm persists, consult Ingeteam.

19.4.4. Reason for contactor shutdown

Code	Alarm	Reason for shutdown	Description
0100H	AC protection	Contactor	The state of the contactor is not correct for the current inverter status. One of the FACn1, FACn2 or FACn3 fuses has been triggered.

The "contactor" reason for shutdown is associated to alarm 0100H. This reason for shutdown requires checking the following points:

1. Check that the value of the auxiliary power supply voltage reaching the equipment is correct.
2. Check the condition of fuses FACn1, FACn2 and FACn3.
3. Check continuity between relay K2n.24 and contactor K1n.A1 and between K1n.A2 and X8n.8.
4. Check continuity between K2n.21 and X8n.4.
5. Check continuity between U1nX2.4 and K2n.A1 and between K2n.2 and XDISn.4.
6. Check continuity between U1nX2.3 and XDISn.2.
7. Check the signalling status. Measure the impedance between terminals XMON.n3 and U1nX3.2. The obtained value must be greater than 2 kOhm.

If the alarm persists, consult Ingeteam.

19.4.5. DC circuit protection

Code	Alarm	Reason for shutdown	Description
0200H	DC protection	DC protection	Blown DC input fuses or DC arresters

The reason for DC protection is associated to alarm 0200H. This reason for shutdown requires checking the following points by following the process described in Section *"19.3. Inverter alarms due to protections"*.

If the alarm persists, consult Ingeteam.

19.4.6. DC insulation fault

Code	Alarm	Reason for shutdown	Description
0400H	DC insulation	DC insulation	Insulation fault in the PV array on inside the inverter

The reason for AC insulation is associated to alarm 0400H. This reason for shutdown requires checking the following points:

1. Follow the disconnection order of the unit specified in Section *"17. Shutting down the unit"*.
2. Measure the voltage between each of the poles of the PV array and ground. Depending on what type of grounding the unit has, you should get the following values, where V_{PV} is the open circuit voltage of the PV array:

Voltage between +ve pole and -ve pole	Voltage between +ve pole and ground	Voltage between –ve pole and ground
V_{PV}	$0.5 \cdot V_{PV}$	$0.5 \cdot V_{PV}$

   If these values are not obtained, the insulation fault is in the PV array. Pinpoint the fault and correct it. Once the insulation fault has been eliminated, reconnect the inverter (see Section *"15.3. Start-up"*).
3. If the insulation fault persists, the fault is inside the unit. Open the inverter and check the status of the DC (RVDC) arresters, as well as all the unit's internal wiring.

   Each of these arresters has an visual indicator. If any of the arresters has been triggered it will need to be replaced.
4. If the insulation fault only occurs when the unit is connected to the grid, check to see whether the insulation fault is in the unit's AC part.

   Check that the impedance of the AC part of the inverter between each of the electronics block outputs (L1, L2, L3) and ground are in the MOhm range. If these values are not obtained, locate the fault and correct it.

   Check that the insulation fault is not in the harmonics filter. To do this open thermomagnetic protection Q2n in each power module and check again that the impedance between each of the outputs of the electronic block (L1, L2, L3) and ground are in the MOhm range.

   Check that the impedance between each of the harmonic filter capacitors (C1n, C2n, C3N) is in the MOhm range. If these values are not obtained, the fault is in the harmonics filter.
5. Check that the insulation fault is not in the fans or other components. To do this open protection QAUX located in the power module No. 1 and measure the impedance between XAUX3.1 and ground and between XAUX3.5 and ground. This should be in the MOhm range. If these values are not obtained, the fault is in the auxiliary services.
6. Verify the condition of the fuses protecting the common mode filter.
7. Close the inverter, reconnect the unit to the grid and to the PV array (see Section *"15.3. Start-up"*).

If the alarm persists, consult Ingeteam.

19.4.7. Manual shutdown

Code	Alarm	Reason for shutdown	Description
1000H	Manual shutdown	Manual shutdown	Manual shutdown due to the opening of a door, emergency push-button, via display or communications.

Within the PV array and depending on the number of power modules, the limit switches are installed at the following locations.

Units with 2 power modules

- 1 in the power DCAC supply module.
- 1 in power module No. 2.

Units with 3 power modules

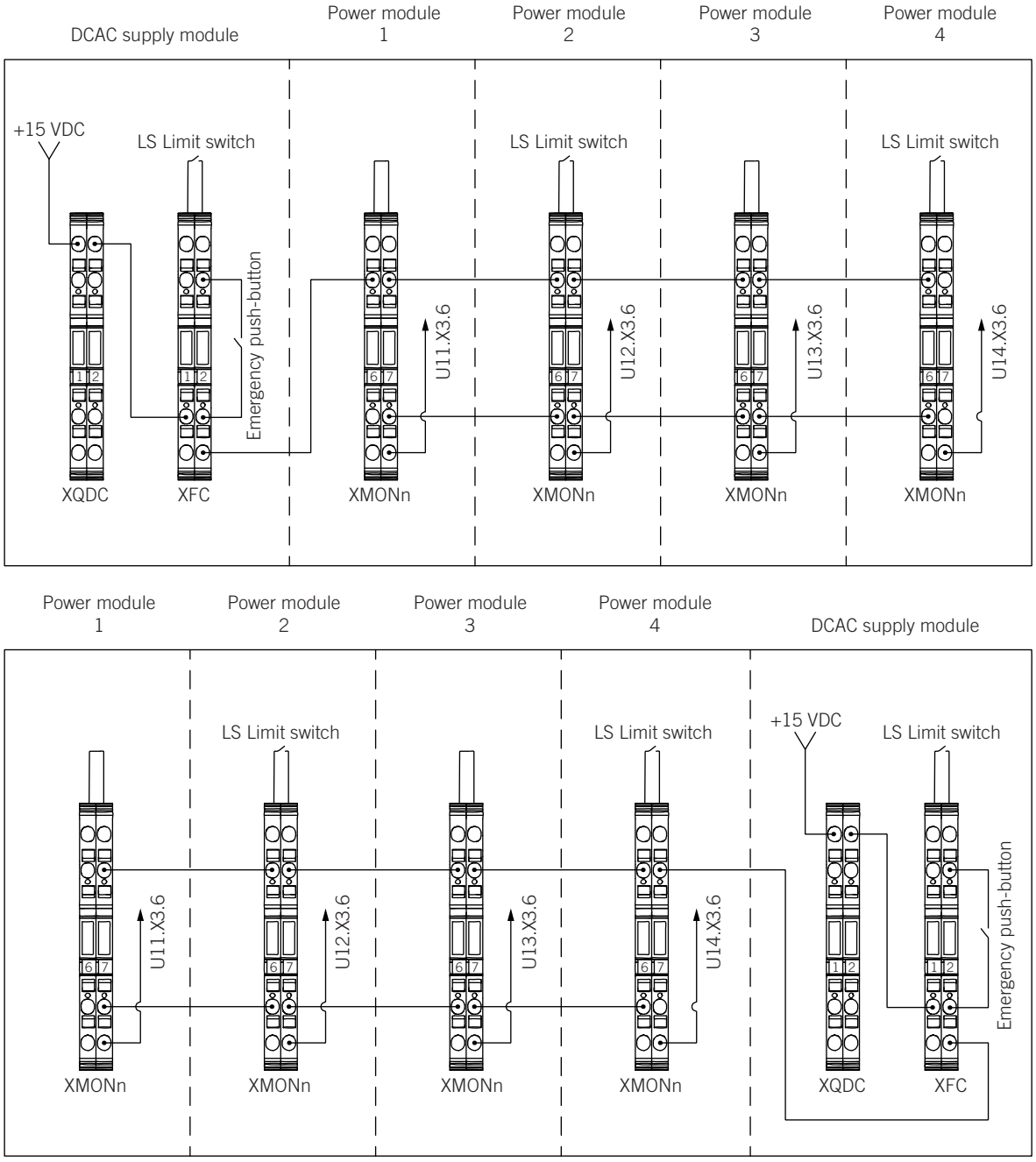
- 1 in the power DCAC supply module.
- 1 in power module No. 2.
- 1 in power module No. 3.

Units with 4 power modules

- 1 in the power DCAC supply module.
- 1 in power module No. 2.
- 1 in power module No. 4.

If there is an undesired manual shutdown alarm, check the monitoring circuit corresponding to the emergency stop button, XQDC and limit switches.

The layout of the circuit to be checked is shown below.



Symmetrical units

19.4.8. AC insulation fault

If the optional AC Insulation monitor kit is installed in the unit, an alarm will be triggered (controlled externally to the unit) indicating said fault.

Once the fault is resolved, verify the condition of the fuses protecting the common mode filter of the unit (F11 and F12).

19.4.9. AC arrester faults

Code	Alarm	Reason for shutdown	Description
0100H	AC protection	AC protection	Error in some of the AC protectors, arresters, fuses, etc.

Once the fault is resolved, verify the condition of the fuses protecting the common mode filter of the unit (F11 and F12).

19.4.10. Faults in the synchronisation of units connected to the same transformer

If there was a synchronisation fault, once the fault is resolved, verify the condition of the fuses protecting the common mode filter of the unit (F11 and F12).

19.4.11. Thermomagnetic circuit breaker Q2n

Thermomagnetic circuit breaker Q2n protects the switching filter. Follow these steps to determine the reason for the breaker thermomagnetic circuit breaker Q2n tripping:

1. Use a multimeter to check that the capacitances of capacitors C1n, C2n and C3N are equal and approximately 90 uF. Replace the condenser if its capacitance decreases by more than 10%.
2. Check that there is continuity between L1, L2 and L3 downstream of Q2n. An easy way to perform this check is to set Q2n to Off and check that there is no continuity between R1n-R2n, R1n-R3n and R2n-R3n.

If the problem persists, contact Ingeteam.

19.4.12. Fatal error

A fatal error status will not allow the unit to be reconnected until it has been reset. This unit status occurs in the following cases:

- Excess temperature of the NTC in any electronics block.
- Excess temperature of the thermal switch in any electronics block.
- Error in one of the cooling system fans.
- Power electronics fault.
- Fault in the K1n contactor control.

The appearance of the fatal error alarm is a result of a relevant error for unit operation. Contact Ingeteam to resolve and reset the error.

Ingeteam accepts no liability for any consequences arising from overlooking this error status.

19.5. Replacing the electronics block

In case of equipment damage requiring the replacement of the electronics block, proceed as follows.

Verify the absence of voltage before performing any operation. Once the inverter is switched off, wait at least 10 minutes until internal capabilities are fully discharged.

To disconnect the unit, follow the instructions in Section *"17. Shutting down the unit"*.

To connect the unit, follow the instructions in Section *"15.3. Start-up"*.

The substitution of the electronics block must be performed by qualified personnel in compliance with the general safety instructions in this manual.

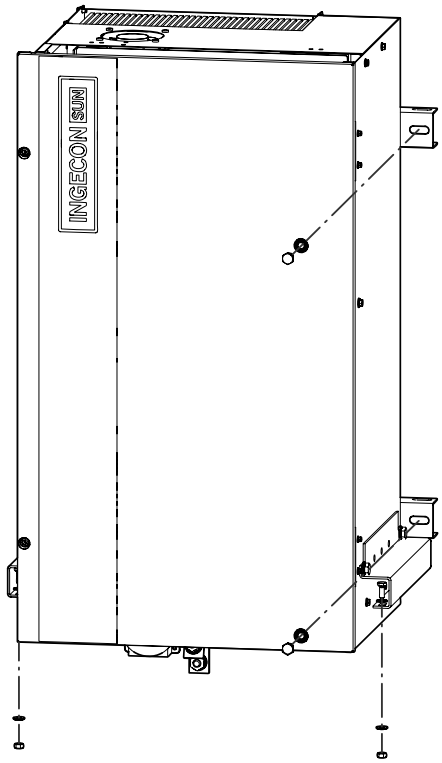
The electronics block is a heavy element. We suggest that it be carried by two people or with mechanical assistance.

The tools needed to replace the electronics block are:

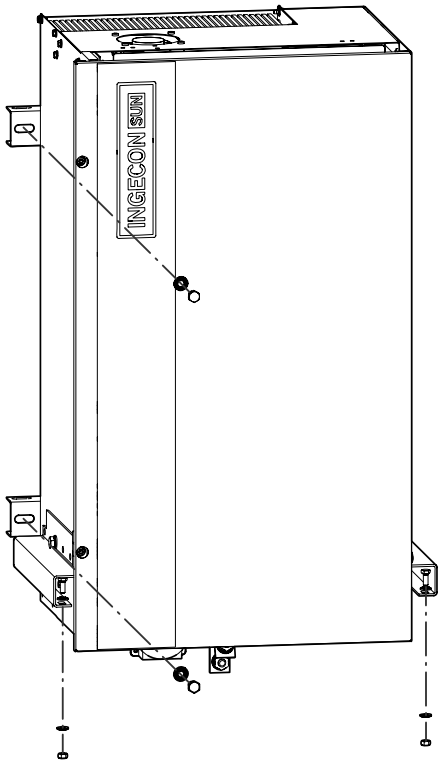
- Flat screwdriver for terminal strip connections and disconnections.
- Ratchet and spanner 17 (M10) for AC and DC connections.
- Ratchet 13 (M8) for fixing the electronics block.
- Ratchet 7 (M4) for removing the top cover.

Once the unit has been disconnected and the internal capacitances have been discharged, proceed in the following order:

1. Check that there is no voltage inside the unit.
2. Disconnect optical fibre cable from the U43 connector.
3. Unscrew the top cover.
4. Disconnect the five power cables at the base of the block (DC+, DC-, L1, L2, L3).
5. Disconnect all the aerial connector entering the terminal (X1, XFN, X2, X3, XAC, XBUS+, XBUS–, XPV+ and XPV–).
6. Disconnect communications board.
7. Disconnect the display cable.
8. Unscrew the four anchor points of the unit in accordance with the diagram. Depending on the position of the electronics block, follow the instructions in the corresponding figure.



Electronics block on the left



Electronics block on the right

9. Remove the electronics block.

For reassembly, perform the same steps in reverse order and then finally configure the electronics blocks:

1. Insert the electronics block in the housing provided.

2. Tighten the four anchor points.
3. Connect the display cable.
4. Connect communication boards or analogue inputs.
5. Insert aerial connectors (X1, XFN, X2, X3, XAC, XBUS +, XBUS–, XPV+ and XPV–) in the terminals on the electronics block.
6. Connect the five power cables (DC+, DC-, L1, L2, L3).
7. Screw on the top cover.
8. Connect the optical fibre cable in the U43 connector.
9. Connecting the unit to the PV array.
10. Configure the can number (see Section *"19.5.1. CAN number setting of an electronics block"*).
11. Configure the node number (see Section *"15.2.1. Configuring the Modbus Node of an electronics block"*).

19.5.1. CAN number setting of an electronics block

Whenever an electronics block is replaced, it will be necessary to check that the CAN number of the new block is the same as the number of the one replaced.

If this is a spare electronics block, it will be factory-configured with the CAN number 1.

This operation will be carried out once the electronics block has been wired correctly, before connecting the AC grid part and the DC PV array part. An auxiliary power supply will need to be connected.

The steps to be followed to modify the CAN number are as follows:

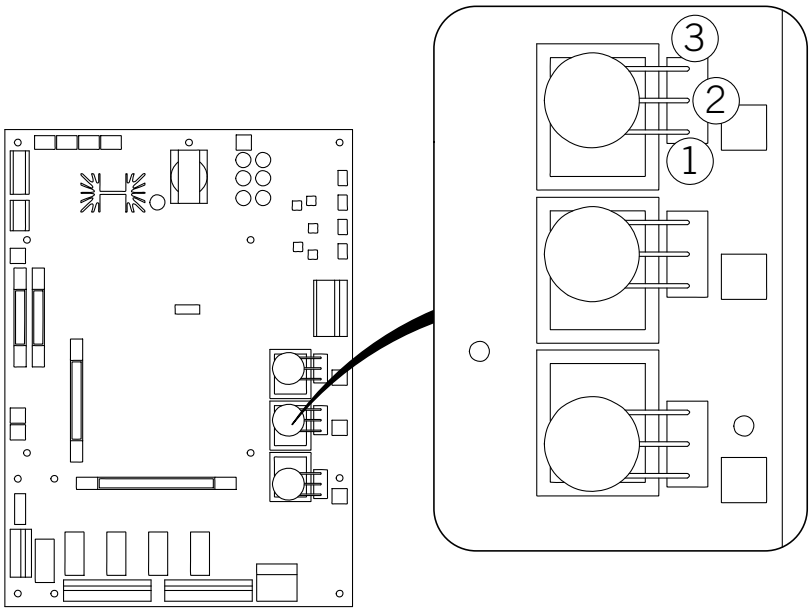
1. Shut down the unit via the display (see Section *"16. Display control"*).
2. Open the door of the corresponding power module. With the unit powered up, opening the door causes a manual shutdown and opens the motorised DC isolating switch.
3. Disconnect the optical fibre cable in the U43 connector of the electronics block to be configured.
4. Open thermomagnetic circuit breaker Q2n on the power module containing the electronics block to configure it.
5. Connect DC and AC supply. The DC supply will only connect when all unit doors are closed correctly. The display will show the 1143 alarm on the node to be configured (node = electronics block).
6. Check that alarm 1143 is active in the electronic block to be configured and that it does not appear in any other block in the unit.
7. In the display (see Chapter *"16. Display control"* for more information), find the "SETTINGS" menu. Select "Change NumCAN". Press OK. When prompted by the display, enter the installer code (3725) and press OK. Input the electronics block node. Repeat steps 1 to 6 for each node to be configured. Once the configuration of all the nodes has been finalized, go to step 8.
8. Reset the alarms. To do so, close the Q2n thermomagnetic circuit breaker located in the power module and connect the optical fibre cables. Alarm 1000 will be displayed.
9. Once all units are properly configured and connected by fibre optic communication cable, connect the unit. See Section *"15.3. Start-up"*.

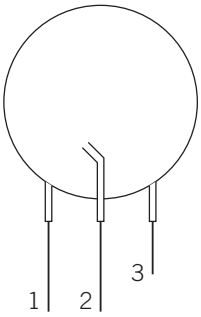
19.6. Replacing varistors in the intake board

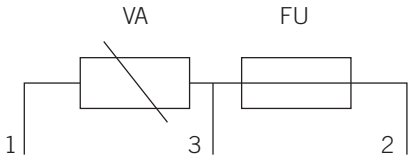
The varistor is connected to pins 1 and 2 on the 3-pin connector on the intake board. Pin 3 is for connecting the thermal fuse.

The varistor must be connected as follows:

- Check continuity of the fuse with the varistor outside the board using the tester.
- Place the varistor on the intake board between pins 1 and 2. The fuse will be placed between pins 2 and 3.







Inserting the varistor back-to-front will destroy it.

20. Waste handling

These units use components that are harmful to the environment (electronic cards, batteries or cells, etc.).

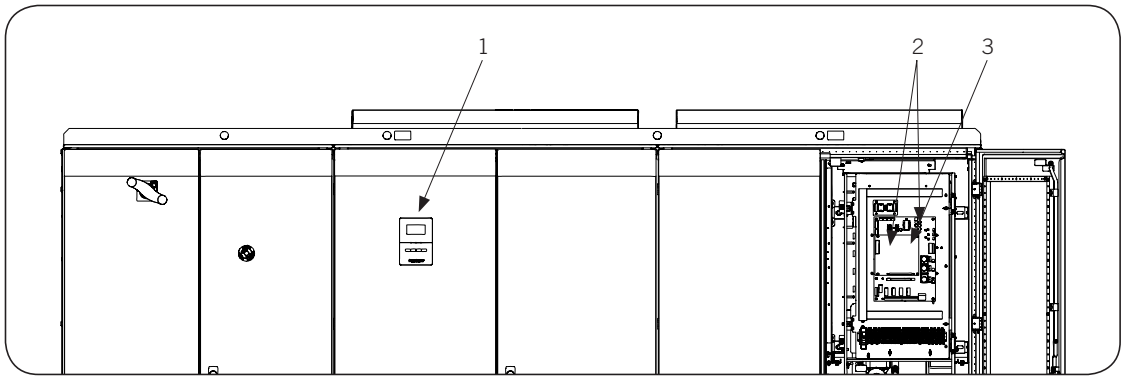
At the end of the unit's life, the waste must be correctly processed by an authorised hazardous waste management company.

Ingeteam, in accordance with its policy of respect for the environment, will inform the authorised manager, via this Section, of the location of components to be decontaminated.

The elements within the unit that must be handled individually are:

1. Liquid crystal displays.
2. Electronics cards.
3. Batteries.

Their location is shown in the following figure.



All power modules feature the same elements pictured in the previous image, except the display, which is only featured on the first power module.

Waste that can be handled by conventional waste collection means

Most of this waste is from the unit's packaging, which must be properly separated and processed.

You can deliver all the packaging to a non-hazardous waste management company.

Notes

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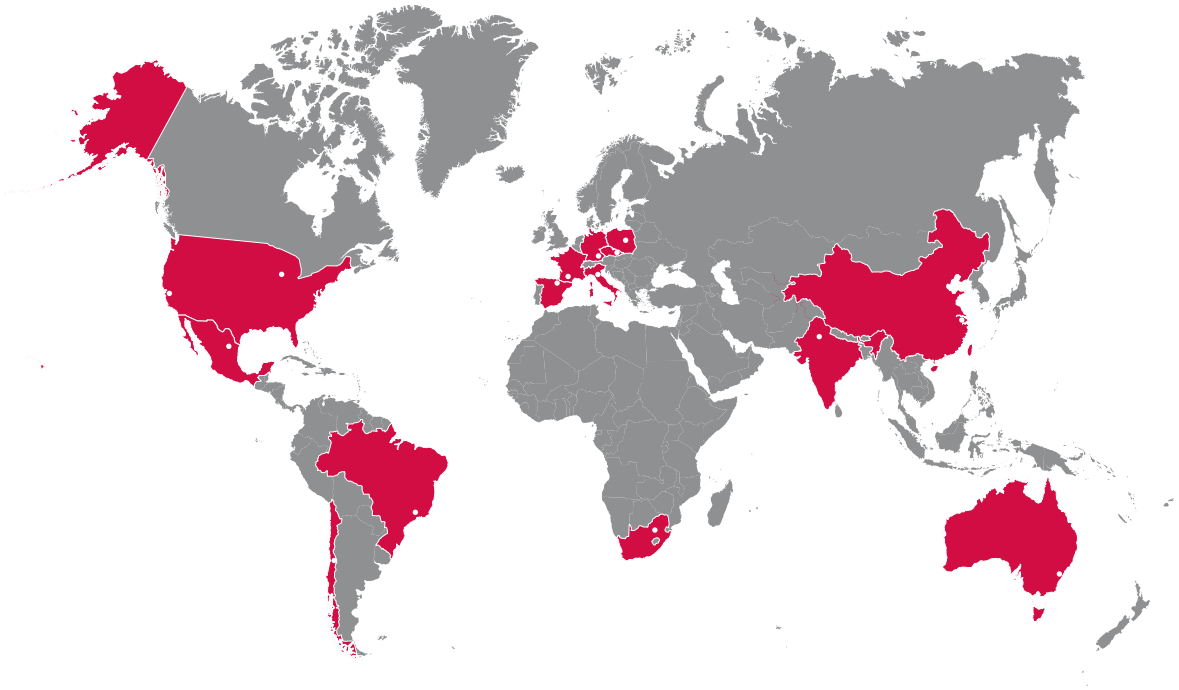

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